JUNE, 1933.

GENERAL PHYSICS.

ADSORPTION.

2098. Rate of Adsorption at Constant Pressure. P. V. McKinney. *J. Phys. Chem.* 37. *pp.* 381–387, *March,* 1933.—The rate of adsorption of hydrogen on the mixed oxides of chromium and manganese is increased by increase of pressure. Repeated adsorption on a surface at a given pressure increases the rate of adsorption to a maximum on the third adsorption, after which it remains steady for a further five adsorptions.

F. J. W.

2099. Studies in Adsorption. Part I. Mechanism of the Activation of Charcoal. Part II. Mechanism of the Adsorption of Vapours by Unactivated Charcoal. L. J. Burrage. *Faraday Soc., Trans.* 29. *pp.* 445–476, *March,* 1933.—Part I. According to the generally accepted theory, activation of charcoal consists of removal, or prevention of formation, of complex hydrocarbons which poison the active points on the charcoal surface and thus render it inactive. In air and steam activation, these bodies are oxidised away, while in chemical activation their formation is prevented by the strong dehydrating nature of the agents employed. The author considers that the latter idea rests on a misconception and arose because the earliest chemical activating agents, such as phosphoric acid and zinc chloride, happened to be powerful dehydrating agents. It was overlooked that these substances are solvents for cellulose. Partly on this fact, and partly on the morphological structure before and after charring and before and after activation, the author bases a new theory, which furnishes an explanation of the mechanism of activation, whether by air, steam, or chemical agents. It is considered that the cellulose, or the charcoal formed from it, is acted on during activation —whether this is effected before or after carbonisation—and that the lignin or its resultant charcoal is untouched. This would result in pitting, which is regarded as the cause of the activation. Various experimental data support this theory in its main outlines. Part II. To throw light on the mechanism of the sorption of vapours by unactivated charcoals, ten isothermals at 25° C. have been determined for substances with dielectric constants between 81 and 2. Measurements have been made of the various amounts of substances which are quasi-chemically held and their dependence on the nature of the particular compounds concerned. The mechanism of the adsorption appears to be highly complex and capable of classification under the headings: (1) At high pressures adsorption takes place according to the magnitude of the dielectric constant. (2) The higher the vapour pressure of the substance concerned, the more effective will be the removal of the surface complex, which may either increase or decrease the amount adsorbed. (3) Certain definite amounts of adsorbed vapour are quasi-chemically held, the amount being dependent on certain atoms and their position in the molecule. (4) Some substances can combine with the complex itself and remove the spongy charcoal complex only very slowly.

T. H. P.

2100. Studies in Adsorption. Part III. Effect of Activation of the Charcoal on the Isothermals of Carbon Tetrachloride. Part IV. Effect of Activation of the Charcoal on the Isothermals of Water, and its Relation to Hysteresis. L. J. Burrage. *Faraday Soc., Trans.* **29.** *pp.* **564–576,** *April,* **1933.**—Part III. The CCl_4 isothermals of a number of charcoals in different stages of activation have been determined at 25° C. The best charcoal for adsorption at low pressures can be made from nut shell, activated by steam, whereas for high pressures the best starting material is peat, activated by chemical means, although chemically activated charcoals contain inorganic materials which may poison some of the active centres and thereby lower the efficiency at low pressures. In making a charcoal of high capacity at either high or low pressures, the nature of the starting material and the method of activation are unimportant, the result depending solely on the degree to which the activation can be controlled. The concentration of the chemical agent, the time and the temperature require careful control to give a charcoal of high capacity at low pressures, and removal of the inorganic matter is desirable. The effect of drift is most prominent in under-activated charcoals; a possible mechanism for this has been advanced [see preceding Abstract]. Part IV. Abundant evidence is obtained of the discontinuity of the water isothermals. Activation does not cause the saturation value to increase as rapidly as with CCl_4; moreover, the latter can be adsorbed only at active centres, whereas water can be sorbed at any point on the surface or by the C_xO_y. As regards the hysteresis loop, there is a continual increase on the quantity axis with increase of activation, the depth of the loop on the pressure axis increasing much more slowly. Comparison of these discontinuous isothermals at any point is not easy, but it seems that the pressure at which the isothermal turns over increases with increase of activation. A mechanism is suggested to explain the effect of activation on the hysteresis loop and the influence of C_xO_y on the water isothermals and hysteresis loop is discussed. T. H. P.

2101. Discontinuities and Nature of Adsorbent Solids. G. H. Piper. *Faraday Soc., Trans.* **29.** *pp.* **538–543,** *April,* **1933.**—Discontinuities in adsorption isotherms are discussed. It is shown that the theory involving the transition of the adsorbed layer from the two dimensional gas to the liquid state is not applicable to all the cases observed. A new mechanism is put forward, based on the assumption of labile links present throughout the adsorbent. The theory leads to a satisfactory explanation of low initial values of heats of adsorption. F. J. W.

2102. Heats of Wetting of Cellulose Acetate by Aliphatic Alcohols and Aromatic Hydrocarbons. S. E. Sheppard and P. T. Newsome. *J. Phys. Chem.* **37.** *pp.* **389–395,** *March,* **1933.**—Measurements have been made of the heat of wetting of an acetone-soluble cellulose acetate (40 % of acetyl) in various non-solvent liquids at 25° C., the heat of wetting being defined as the calories evolved per gram of dry material when immersed in sufficient liquid to ensure complete wetting. This heat decreases with increase in molecular weight in a homologous series (alcohols, aromatic hydrocarbons), and the time required for the maximum rise in temperature to develop—which is taken as a measure of the rate of penetration of the liquid—increases with the molecular weight. The heat of wetting in ethyl alcohol is 5·65, or, assuming the molecular weight 267, 1509 cal. per mol., and in benzene, 7·57 (2021 cal. per mol.). In water the heat of wetting is 6·0 for precipitated and about 7 for the sheet acetate. These results differ widely from those of Knoevenagel [*Kolloidchem. Beihefte*, 16. *p.* 180, 1922], who postulated definite (stoichiometric) solvate formation for the sorption of liquids by cellulose esters. The present results fail to support this view, and doubt is expressed as to the reliability of Knoevenagel's experimental methods. The graphs of the heats of wetting against the corresponding total sorptions for the two homologous series [see Abstract 3021 (1932)] indicate that capillary condensation in the alcohol series ceases at n-propyl alcohol and in the aromatic hydrocarbon series at toluene. Prolongation of these curves through the origin permits of the determination of the surface adsorption necessary to account for the heats of wetting of benzene and of methyl and ethyl alcohols ; the excess sorption is due to capillary condensation and gives a measure of the pore volume filled by the liquid. Methyl alcohol gives the largest capillary condensation, the pore volume thus occupied being 0·389 c.c. per gram of dry acetate. The net heat of adsorption is 2·3 cal. per millimol of adsorbed liquid for the benzene series, and 1·15 cal. for the alcohol series. Following Bartell and Fu's method [*Coll. Sympos. Monograph* 7. *p.* 135, 1929] the specific area of cellulose acetate is calculated to be $2 \cdot 4 \times 10^6$ sq. cm. ; the value, $5 \cdot 9 \times 10^6$, previously obtained from the total molar adsorption at the saturation pressure [see Abstract 3021 (1932)], is possibly too high owing to capillary condensation of the higher alcohols. T. H. P.

2103. Investigation of Thin Surface Films on Metals by Means of Reflected Polarised Light. L. Tronstad. *Faraday Soc., Trans.* 29. *pp.* 502–514, *March*, 1933.—The application of Voigt and Drude's optical method to the study of surfaces is considered. The principle of the method is as follows : When reflected at a metal surface, a beam of polarised light suffers a change in its state of polarisation. The change depends on the angle of incidence and on the optical properties of the metal, being affected by a surface film as well as by the surrounding medium. Consequently, if the angle of incidence is known, as well as the optical properties of the clean metal surface and of the surrounding medium, it is possible from measurements of the change in the polarisation to draw conclusions as to the optical and other properties of any surface film present. By using monochromatic light of different wave-lengths, information regarding the dispersion of the film can also be obtained. This method may be used also on non-absorbing media (glass, water, etc.) covered with surface films, but this introduces difficulties owing to the low intensity of the reflected beam. The theoretical aspects of the method are considered, and results obtained with it in investigating passivity of metals, oxidation of metals, adsorption on metals, and unimolecular films on metals are recorded. Its use in the study of heterogeneous catalysis and surface migration is also discussed. T. H. P.

2104. New Method for Obtaining Data for the Sorption of Vapours by Solids. J. L. Porter. *J. Phys. Chem.* 37. *pp.* 361–366, *March*, 1933.—A simple method for the rapid and moderately accurate study of sorption of liquids and vapours by solids is described. The sorption of water, formamide, formic acid, methyl alcohol, ethylene oxide and methyl cyanide on chabasite, and of water, benzene and acetic acid on charcoal are investigated. The isotherms for chabasite are interpreted as due to persorption and not capillary condensation. F. J. W.

ATOMIC AND MOLECULAR STRUCTURE.

2105. Atomic Masses of Ne^{20}, B^{11}, Ne^{22} and F^{19}. K. T. Bainbridge. *Phys. Rev.* 43. *pp.* 424–427, *March* 15, 1933.—The author has determined the atomic masses of Ne^{20}, Ne^{22} and B^{11} in a mass spectrograph. Ne^{20} is given as $19\cdot9967 \pm 0\cdot0009$, Ne^{22} as $21\cdot9947 \pm 0\cdot0009$ and B^{11} as $11\cdot0107 \pm 0\cdot001$. The latter agrees satisfactorily with Aston's value, but the others differ considerably. Various suggestions are made as to the causes of error in Aston's experiments. The mass of Ne^{22} can also be calculated from the artificial disintegration experiments of Chadwick and Constable [see Abstract 2889 (1932)] and agrees much better with the author's than with Aston's value. The residual difference is attributed to an error in Aston's determination of the mass of F^{19} and another value is proposed. J. E. R. C.

2106. Three-Electron Bond in Chlorine Dioxide. L. O. Brockway. *Nat. Acad. Sci., Proc.* 19. *pp.* 303–307, *March*, 1933.—The excellent agreement between the observed value 1·58 Å and that predicted for the Cl–O distance (1·57 Å) substantiates the validity of the three-electron bond structure to account for the stability of ClO_2 and in particular its lack of tendency to polymerise to Cl_2O_4. H. H. Ho.

2107. X-Ray Investigation of Atomic and Molecular Structure. J. Weigle. *Arch. des Sciences*, 14. *pp.* 351–362, *Nov.–Dec.*, 1932.—The author gives a general account of scattering of X-rays by monatomic and polyatomic gases. The information yielded by scattering experiments is discussed. J. E. R. C.

2108. Determination of the Structures of the Hexafluorides of Sulphur, Selenium and Tellurium by the Electron Diffraction Method. L. O. Brockway and L. Pauling. *Nat. Acad. Sci., Proc.* 19. *pp.* 68–73, *Jan.*, 1933.—Following Mark and Wierl [see Abstract 3904 (1932)], who first applied the methods of electron diffraction to the study of gas molecules the authors determine the atomic configuration and inter-atomic distances in SF_6, SeF_6 and TeF_6; the values obtained for the respective inter-atomic distances are: $1\cdot58 \pm 0\cdot03$ Å, $1\cdot70 \pm 0\cdot03$ Å, $1\cdot84 \pm 0\cdot03$ Å. The inter-atomic distances agree very well with those expected for an ionic structure. H. L. B.

2109. Model of Diatomic Rotator with Two Degrees of Freedom. L. Simons and E. H. Smart. *Phys. Soc., Proc.* 45. *pp.* 266–270, *March* 1, 1933.—An arm 5 in. long is pivoted at one end and carries at the other end a small electric lamp which is then capable of moving on the surface of a sphere about the pivot as centre. The two angular velocities ϕ and θ can be independently controlled by two hand-regulated motors: ϕ is the azimuthal and θ the co-latitudinal angular coordinate of the arm. If ϕ and θ are commensurable, the resulting figure traced out by the lamp remains stationary in space. This path represents the motion of one of the atoms of the rotator which has two degrees of freedom. AUTHORS.

2110. Structure of Alkali Hydride Molecules. A. Krebs. *Zeits. f. Physik*, 81. 1–2. *pp.* 1–2, *March* 3, 1933.—Referring to his earlier calculations on the alkali hydrides [see Abstract 1507 (1933)] the author in this paper quotes the results of various investigations and discusses the question how far the alkali hydrides in the gaseous condition form ionic or atomic molecules. J. J. S.

2111. Structure of CH_4 and Related Molecules. Part I. J. H. van Vleck. *J. Chem. Phys.* 1. *pp.* 177–182. *March,* 1933.—A critical comparison is given of the Slater-Pauling and Hund-Mulliken concepts of methane, which are based respectively on localised bonds (" electron pairs ") with the Heitler-London method, and on one-electron wave functions (Mulliken's " orbitals ") for a self-consistent field with tetrahedral symmetry. The H.-M. procedure avoids hybridisation of the carbon 2S and 2*p* wave functions, but allows two (though never three or more) electrons to accumulate on one H-atom, as well as up to eight on a C-atom. Inadequate cognisance is thus taken of the tendency of inter-electronic Coulomb forces to keep two electrons apart. The S.-P. procedure avoids this excessive accumulation, but at the expense of not letting an individual wave function be of a symmetry type (irreducible group representation) appropriate to a tetrahedral field; in particular, its S-*p* hybridisation " undiagonalises " the internal energy of the C-atom. These points are illustrated by explicit exhibition of the secular determinant, which is the main new feature. Because inter-electronic repulsions make the dynamical problem more complicated than a one-electron one, the tetrahedral symmetry need only be preserved in the properties of the total wave function of the entire system rather than that of one electron, but the departures from individual tetrahedral symmetry should be less than in the S.-P. theory if the Hartree self-consistent field is really a good approximation. Thus both the H.-M. and S.-P. methods have limitations unless refined by inclusion of higher approximations which ultimately merge the two methods but which practically are very difficult to make. [See following Abstract.] H. H. Ho.

2112. Structure of CH_4 and Related Molecules. Part II. J. H. van Vleck. *J. Chem. Phys.* 1. *pp.* 219–238, *April,* 1933.—Explicit calculations are made to examine whether the tetrahedral model of CH_4 is really the most stable in the Hund-Mulliken and Slater-Pauling theories [see preceding Abstract]. The secular determinant involved in the H-M procedure is too complicated (degree 8) to solve generally, but three methods of approximation are given applicable in three different limiting cases, in all of which the tetrahedral model proves to be that of least energy quite irrespective of repulsions between the H atoms. The fact that two of the methods do not assume the carbon S-*p* separation to be small shows that S-*p* hybridisation is not a necessary condition for tetrahedral valence bonds. Calculations are also given which show that in the Heitler-London-Pauling-Slater method the regular tetrahedron is superior to other models of somewhat lower symmetry, and that in compounds of the form CH_2X_2, CHX_3, and CH_3X, the most stable models are tetrahedra of less symmetry than the regular tetrahedron; *i.e.*, models with the valence angles somewhat distorted from 109·5°, unless the C-H and C-X bonds are of equal intensity. The predicted deviations are in agreement with X-ray diffraction data for CH_2Cl_2 and $CHCl_3$. The angle between two bond axes is shown to be anything between 90° and 180° depending on the relative intensities of the S and *p* bonds. CH_4^+ is found to be a flattened rather than regular tetrahedron, conceivably even being plane, while CH_3 should be a flatter pyramid than NH_3. H. H. Ho.

2113. Characteristic Vibrations in Valency Systems with Four Centres of Gravity. F. Lechner. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 9–10. *pp.* 633–637, 1932.—The treatment previously given for systems with

three centres of gravity is applied to six cases, typified by ammonia, the carbonate ion, phosgene, the two forms of dichloroethane and acetylene.
H. F. G.

2114. Calculation of Matrix Elements for Lewis Electronic Structures of Molecules. L. Pauling. *J. Chem. Phys.* 1. *pp.* 280–283, *April,* 1933.—Starting from the discovery by Rumer that the eigenfunctions corresponding to different distributions of valence bonds in a molecule can be represented by plane diagrams which provide information regarding their mutual linear independence, a very simple graphical method is developed for calculating the coefficients of the integrals occurring in the matrix elements involved in Slater's treatment of the electronic structure of molecules [see Abstract 333 (1932)]. AUTHOR.

2115. Revision of the Atomic Weight of Arsenic. Parts I and II. Analysis of Arsenic Tribromide and Trichloride. G. P. Baxter, W. E. Shaefer, M. J. Dorcas and E. W. Scripture, Jr. *Am. Chem. Soc., J.* 55. *pp.* 1054–1066, *March,* 1933.—The preparation and fractionation of the two halides is described. Analysis of the tribromide yields, as the average, 74·90, and of the trichloride 74·906, for the atomic weight of arsenic, as compared with the international value of 74·93. H. F. G.

See also Abstracts 2219, 2243, 2246, 2327, 2331, 2342, 2343, 2413, 2414, 2446, 2454, 2462, 2465, 2479, 2492, 2540, 2577, 2616.

COLLOIDS.

2116. Mechanics of Gelation. E. G. Richardson. *Faraday Soc., Trans.* 29. *pp.* 494–502, *March,* 1933.—Attention is drawn to the value, for the simultaneous study of viscosity and elasticity, of the oscillating disc apparatus used by Meyer for studying the viscosity of homogeneous liquids [*Ann. d. Physik,* 113. *p.* 85, 1861]. Detailed experimental analysis of gelation apparently indicates two more or less distinct molecular processes: (1) In its gradual acquisition of viscosity, which is anomalous in that it varies with the rate of shear, the sol resembles a suspension of which the disperse phase is increasing in size or occupying a greater proportion of the whole volume. (2) In a gel these aggregates link together throughout the substance, binding the structure so that rigidity is acquired. With agar gel this cohesive force is very strong and the gel is very difficult to disrupt. The transformation represented by (2) is extremely sudden and leads to the acquisition of elasticity, which distinguishes the gel from a suspension. If the latter is sufficiently concentrated, parts of it may move as a whole under small shearing forces, but it will always yield eventually to a sufficient shearing force. It does not seem necessary to postulate, as Pichot does, a minimum critical shearing force [see Abstract 3525 (1932)]. T. H. P.

2117. Structure of Electro-Silver Sols. E. Einecke. *Zeits. f. Elektrochem.* 39. *pp.* 126–131, *March,* 1933.—An electrical metal-atomising apparatus for preparing sols by Bredig's method is described. With silver sols thus prepared, the contents of silver and silver oxide in relation to the total concentration and to the addition of protective colloid have been investigated. These sols contain no silver peroxide. Reductions of protected sols by Kohlschütter's method proceed very slowly and incompletely, even at high temperatures, this being attributed to gumming of the platinum. Electrochemically good results are quickly obtained, if heated solutions are used; here also the efficiency falls as the content of gum arabic in increased but the action on the polarised platinum is less. Oxide-free protected sols are extremely stable, even at boiling point. On the other hand, colloids prepared without gum arabic flocculate completely after electrolysis for two hours at a moderate temperature, but when the oxide-content is small—as it is after one hour's electrolysis—the dilute sols keep well. A sol prepared by the electrolysis of water with silver electrodes consists largely of silver oxide. When aqueous alcohol is similarly electrolysed, metal trees form at the kathode. T. H. P.

2118. Apparatus for Electrophoresis. (Miss) Choucroun. *Comptes Rendus*, 196. *pp.* 777–780, *March* 13, 1933.—The necessary features of suitable apparatus are discussed. In order to obviate disturbance due to H and OH ions, contact with the electrodes should be made through a solution of relatively high conductivity. Under suitable conditions it is thus possible to concentrate colloidal solutions without otherwise altering them ; to separate two groups of differently charged particles ; and to investigate more fully certain biological fluids. H. F. G.

2119. Electrical Properties of Colloids. Part I. Explanation of Activity and Conductivity Measurements in Colloidal Solutions. I. N. Mukherjee. *Kolloid Zeits.* 62. *pp.* 257–268, *March*, 1933.—The various theories dealing with the electrical properties of colloidal solutions are briefly discussed, particularly in relation to the following points : transition from normal to colloidal electrolytes ; dissociation, electrical adsorption and association of the mobile ions associated with the charged colloidal particles ; valency of the " colloid ion " ; dissociation constant of the " colloid " salt or acid ; activity of the mobile ions in relation to interionic attraction or repulsion ; stoichiometric concentration of the colloid particles and the " colloid-chemical equivalent " ; significance of cataphoretic velocity ; relation of cataphoretic velocity to charge-density at the surface and to conductivity coefficients. The migration method for determining cataphoretic velocity is criticised and its limitations defined. Theoretical considerations show that colloidal solutions manifest characteristic behaviour, which is determined by the peculiarities in the distribution of the electrical charges due to primary and electrical adsorption and to equilibrium-distribution of the ions. T. H. P.

2120. Ionic Theory of Electroosmosis, Stream Current and Surface Conductivity. J. J. Bikerman. *Zeits. f. phys. Chem.* 163. *Abt.A.* 5–6. *pp.* 378–394, *March*, 1933.—Equations for the most important electrokinetic phenomena are developed from the Gouy theory of the " diffuse " double layer. The Helmholtz formula for electroosmosis is confirmed, and the least width for the slit for which the formula holds, is calculated. The surface conductivity is found to vary with the frequency of the alternating current. Transport numbers are altered by electroosmosis and ionic adsorption, and equations are developed for these variations. The Helmholtz formula for the " streaming current " is only correct if the slit is not too narrow. F. J. B.

2121. Diffuse Double Layer. J. Lens. *Roy. Soc., Proc.* 139. *pp.* 596–604, *March* 3, 1933.—The author extends the original theory given by Gouy for two double layers under each other's influence and produces experimental evidence in support of his conclusions. Some results of the theory are discussed. J. E. R. C.

2122. Quantitative Interpretation of the Viscosity and Double Refraction of Flowing Suspensions. W. Kuhn. *Kolloid Zeits.* 62. *pp.* 269–285, *March*, 1933.—This paper contains a very comprehensive experimental investigation of the orientation of the particles in flowing suspensions by viscosity and, where possible, double-refraction determinations. Disturbances due to Brownian movements are taken into account, as well as the distortion of particles by flow which may render them doubly refracting. Theoretical discussions are included, together with copious references to previous work. H. H. Ho.

2123. Silicic Acid Gels. Part III. C. B. Hurd and D. H. Carver. *J. Phys. Chem.* 37. *pp.* 321–329, *March*, 1933.—Observations of the time of setting of gels, made from sodium silicate solutions and acetic acid, at different pH values and with addition of various organic substances. Bases decrease time by their effect on the pH of the mixture, but triethylamine shows an additional specific effect. Alcohol, aldehyde and acetone increase time without effect on pH. A. S. C. L.

2124. X-Ray Fibre-Diagrams of Cellulose. W. Schramek. *Zeits. f. phys. Chem.* 20. *Abt.B.* 3–4. *pp.* 209–216, *March*, 1933.—It is shown that very great care must be taken in the use of X-ray fibre-diagrams of cellulose and its derivatives for determining the mechanism of reactions, especially when photometric measurements are not made. Observations based on the sharpness or breadth of the reflections are of no value unless it has been definitely shown that no intermediate stages occur in the change over from one lattice form to another. In conclusion it is shown that during the transition from soda-cellulose to hydro-cellulose a new cellulose modification occurs. J. T.

2125. Formation of Emulsions by Supersonic Vibrations. W. Daniewski. *Acta Physica Polonica*, 2. 1. *pp.* 45–49, 1933.—Variation of rate of emulsification of petrol in water with frequency and energy of supersonic waves has been observed. At frequencies of 9000 and 3000 kc. no emulsification occurs but some at 1160. The rate then increases with fall of frequency to 395 and 150. A. S. C. L.

2126. Formation, Size and Stability of Emulsion Particles. C. G. Sumner. *J. Phys. Chem.* 37. *pp.* 279–302, *March*, 1933.—Emulsions were formed by passing benzene vapour into dilute aqueous solutions of sodium oleate through a small orifice. The degree of dispersion was independent of the temperature of the vapour and was increased by increasing concentration of soap. A. S. C. L.

2127. Rhythmic Precipitation in Stretched Gels. A. Boutaric and J. Ratélade. *Comptes Rendus*, 196. *pp.* 692–693, *March* 6, 1933.—When a strip of cellophane or cellulose acetate impregnated with a solution of potassium bichromate, or chromate, is maintained under longitudinal tension with one end immersed in a solution of silver nitrate a series of lines, consisting of silver chromate, is formed each consisting of minute elliptical spots. The line are perpendicular, the major axes of the ellipses parallel, to the direction of tension, and increase in distance apart and length respectively with distance from the solution. C. A. S.

See also Abstract 2351.

CRYSTAL STRUCTURE AND PROPERTIES.

2128. Theory of Double Salts: Manganous Thorium Sulphate —New Type of Double Salt. R. M. Caven. *Roy. Techn. Coll., Glasgow, J.* 3. *pp.* 36–46, *Jan.*, 1933.—In this paper the general theory of double salts is discussed, especially with reference to their individuality, and the disposition of their water of crystallisation. This serves as an introduction to the description of a new double salt, manganous thorium sulphate. AUTHOR.

2129. Structure of Crystals. U. Dehlinger. *Physik,* I. 1. *pp.* 7–20, 1933.—A report dealing with modern work on the following topics—methods of investigation, determination of structure, crystal chemistry, deviations from periodicity (*i.e.,* " real " and " theoretical " lattices), growth. F. I. G. R.

2130. Velocity of Nucleus Formation and Ostwald's Step Rule. I. N. Stranski and D. Totomanow. *Zeits. f. phys. Chem.* 163. *Abt. A.* 5–6. *pp.* 399–408, *March,* 1933.—Theoretical considerations show that Volmer's theory of nucleus formation [see Abstract 1682 (1926)] furnishes an explanation of Ostwald's step rule for the special case when polymorphic modifications arise and also of the temperature course of the nucleus number with supercooled melts. The experimental data for the crystallisation of sodium bromide and for the sublimation of mercuric iodide are in accord with the theory. It is found that, when mercuric iodide is sublimed, crystals of the red modification may be formed directly. T. H. P.

2131. Determination of Crystal Orientation. J. Thewlis. *Zeits. f. Krist.* 85. 1–2. *pp.* 74–88, *March,* 1933.—A graphical method, in which the indices or direction cosines are represented by the co-ordinates of a graph, isogonals being drawn for each reflecting plane. The angles in question are those between the normal and the various crystal directions. F. I. G. R.

2132. Crystal Structure of the Compound $LaAl_4$. A. Rossi. *Accad. Lincei, Atti,* 17. *pp.* 182–188, *Jan.* 22, 1933.—This compound forms crystals which belong to the dimetric system and cleave along the pinacoid faces (001). The holohedral symmetry of Laue's photogram indicates one of the space groups V^d, C^v_4, D_4, D^h_4. The results of the X-ray examination are not conclusive, but most probably $a_0 = 13\cdot 2$ Å. and $c : a = 0\cdot 77$. On the assumption that the unit cell contains sixteen molecules, the calculated density is 3·69, the experimental value being 3·86. T. H. P.

2133. Valency Electron Rule and Atomic Radii of Base Metals in Alloys. E. Zintl and G. Brauer. *Zeits. f. phys. Chem.* 20. *Abt. B.* 3–4. *pp.* 245–271, *March,* 1933.—The authors have examined a number of binary alloys, each containing 50 % (atomic) alkali metal or alkaline earth. LiAg, LiHg, LiTl, MgTl, CaTl, SrTl have β-brass structure while LiZn, LiCd, LiGa, LiIn have NaTl structure. The Hume-Rothery, Westgren and Phragmén rule is found to be invalid for the alloys containing Li, Na, Mg, Ca, Sr. Decreased atomic distances occur in the alloys containing these metals, and this is attributed to a contraction of the atomic radii; *e.g.,* the Li atom is 12 % smaller in LiZn than in the free metal. Reasons for the results are discussed. [See following Abstract.] W. E. P.

2134. Lattice Structure of NaIn and Deformation of Atoms in Alloys. E. Zintl and S. Neumayr. *Zeits. f. phys. Chem.* 20. *Abt. B.* 3–4. *pp.* 272–275, *March,* 1933.—The authors have examined an alloy NaIn having NaTl structure. The Na atom has a 15 % smaller radius in the alloy than in the free metal, and exhibits the largest contraction of any base metals hitherto investigated. Variation of the atomic radius of In also occurs. Comparison of atomic radii determined from other NaTl structures shows that the contraction of base atoms in binary alloys is greater the greater the base atoms and the smaller the atom of the other component of the alloy. [See preceding Abstract.] W. E. P.

2135. Crystal Structure of Precipitated Copper-Tin Alloys. H. Kersten and J. Maas. *Am. Chem. Soc., J.* 55. *pp.* 1002–1004, *March,* 1933.—The addition of tin to a dilute, aqueous, hot, 1 % solution of copper sulphate, containing less than 12 c.c. of concentrated sulphuric acid per litre precipitates an alloy of the same composition and crystal structure as that of the CuSn phase prepared by fusion. If the solution contains more than 20 c.c. of concentrated sulphuric acid per litre, an alloy corresponding in composition and crystal structure to that of the α-phase of the copper-tin system is precipitated. F. J. B.

2136. Lattice Constants and Grain Size in Gold-Silver Alloys. P. Wiest. *Zeits. f. Physik.* 81. 1–2. *pp.* 121–128, *March* 3, 1933.—The lattice constants of Au-Ag alloys are determined by a precision method. Single crystals and recrystallised polycrystalline material are examined. The lattice constant is found to be a minimum for 75 % Au (atomic). By deforming a single crystal and recrystallising by heating at 900°C. the lattice constant is decreased. The biggest effect is obtained for alloys corresponding to 75 % Au (atomic). In this case the length of a side of the unit cube is 4·0673 Å. for a single crystal and 4·0645 Å. for the polycrystalline alloy. Additional deformation of recrystallised alloys together with heating at 1000°C. for periods up to ten hours, which results in the production of big grains, causes very little alteration in lattice constant. Large grained material extracted from the melt gives the same lattice constant as a single crystal. J. T.

2137. X-Ray Study of Phase Boundaries in Thermal Diagrams of Alloy Systems—Cu-Zn System. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 137. *pp.* 397–417, *Aug.* 2, 1932.—Parameter values of the lattices of the different phases in the Cu-Zn alloy system (composition range 100 % to 30 % copper by weight) are determined with an accuracy of 1 in 4000 by photographing reflected X-ray lines with a precision camera. Care is taken that the samples are adequately annealed. The determination of phase boundaries is based upon the observations that in a pure phase region the parameter changes with composition but not with temperature, whereas in a mixed region the parameters of both lattices change with temperature but not with composition. At any given temperature the parameters of a phase in its two mixed regions are different. Composition-parameter graphs corresponding to the different phase regions are plotted for annealing temperatures ranging from 350°C. to 800°C., and the phase boundary compositions are read off from the points of sudden change of slope. This X-ray method of boundary determination is more expeditious than other methods, while comparison shows that it gives at least as high an accuracy. L. A. W.

2138. X-Ray Study of Copper-Cadmium Alloys. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 139. *pp.* 526–541, *March* 3, 1933.—Alloys covering the whole range of the copper-cadmium system are examined by X-ray powder methods. Ordinary powder photographs are used in general, but a precision camera is employed in a detailed examination of the α-phase. The β-, γ-, and ε-phase structures are too complex to be solved by the photographs taken, but the δ-phase structure is found to be similar to that of γ-brass. Care is taken in the annealing processes, which are described in detail, in order to ensure that true equilibrium is attained. The study of the α-phase shows that the solubility of cadmium in copper decreases with decreasing temperature. The limits of solubility at 500°C., 400°C. and 300°C., are 97·8 % copper, 99·0 % copper and 99·5 % copper respectively. Accordingly a modification in the $(\alpha) - (\alpha + \beta)$ boundary of the equilibrium diagram is suggested. J. T.

2139. Crystal Structure of Aluminium Halides : Part I. AlF_3. J. A. A. Ketelaar. *Zeits. f. Krist.* 85. 1–2. *pp.* 119–131, *March*, 1933.—The structure is investigated by Laue photographs, rotation photographs and powder photographs. AlF_3 is found to be rhombohedral. The space group is D_3^7. The size of the unit hexagonal cell is found to be: $a = 4{\cdot}914$Å. ± 0·005, $c = 12{\cdot}46$Å. ± 0·01. This contains 6 molecules. The size of the rhombohedral unit cell is found to be : $a = 5{\cdot}029$Å. ± 0·005, $\alpha = 58°31'$. This contains 2 molecules. The Al atoms are at (uuu), $(\bar{u}\bar{u}\bar{u})$, with $u = 0{\cdot}237 \pm 0{\cdot}002$, and the F atoms are at $(u\bar{u}o)$, $(\bar{u}ou)$, $(ou\bar{u})$, with $u = 0{\cdot}430 \pm 0{\cdot}003$ and $(u\bar{u}\tfrac{1}{2})$, $(\bar{u}\tfrac{1}{2}u)$, $(\tfrac{1}{2}u\bar{u})$, with $u = 0{\cdot}070 \pm 0{\cdot}003$. The structure is based on deformed close-packing of F atoms. J. T.

2140. Lattice-Constant of the Rhombohedral Face of Quartz. V. Kunzl and J. Köppel. *Comptes Rendus*, 196. *pp.* 787–789, *March* 13, 1933.—Value for (1011) = d_{∞} = 3336·66 X.U. F. I. G. R.

2141. Symmetry of Boracite. R. Hocart. *Comptes Rendus*, 196. *pp.* 789–791, *March* 13, 1933.—An X-ray study, leading to the conclusion that this compound is orthorhombic. F. I. G. R.

2142. Crystal Systems of Microcrystalline Ferric Oxides. A. Girard and G. Chaudron. *Comptes Rendus*, 196. *pp.* 925–927, *March* 27, 1933.—Magnetisation/temperature curves indicate that the apparently colloidal precipitate obtained by rapid oxidation in large excess of oxygen at the ordinary temperature of $Fe(OH)_2$ in a basic medium consists of very fine particles of cubic Fe_2O_3 ; but the similar precipitate obtained if the medium is acid is not ferromagnetic and gives a hazy rhombohedral X-ray diagram. A mixture of cubic and rhombohedral Fe_2O_3 is obtained by rapid dehydration of lepidocrocite. The cubic variety alone is formed by hydrolysis of lithium or potassium ferrite at the ordinary temperature, or by oxidation at 100° of precipitated hydrated Fe_3O_4.
C. A. S.

2143. Crystal Structure of Silver Per-rhenate. F. Buschendorf. *Zeits. f. phys. Chem.* 20. *Abt. B.* 3–4. *pp.* 237–244, *March*, 1933.—Investigation by Debye-Scherrer method. Crystals optically uni-axial, positive. Double-refraction approximately 0·013. Space-group C_{4h}^6. $a_0 = 5{\cdot}349 \pm 0{\cdot}03$Å., $c_0 = 11{\cdot}916 \pm 0{\cdot}03$Å., $c_0/a_0 = 2{\cdot}228$, $c/a = 1{\cdot}575$. The volume of the elementary cell is 340·88Å., corresponding to a density of 7·05, with four molecules in the unit cell. Isomorphous with tetragonal Scheelite structure. F. I. G. R.

2144. Crystal Structure of Yttrium Vanadate. E. Broch. *Zeits. f. phys. Chem.* 20. *Abt. B.* 5–6. *pp.* 345–350, *April*, 1933.—Lattice dimensions, $a = 7{\cdot}126$Å., $c = 6{\cdot}197$Å., $c/a = 0{\cdot}891$. Four molecules are contained within the unit cell: space-group D_{4h}^{19}. Each Y atom is surrounded by four O atoms at a distance of 2·30Å., and by four more at 2·73Å., so that the co-ordination is (4 + 4) fold rather than 4-fold.
F. I. G. R.

2145. Nickel Carbide and its Relation to other Carbides of the Scandium-Nickel Element Series. B. Jacobson and A. Westgren. *Zeits. f. phys. Chem.* 20. *Abt. B.* 5–6. *pp.* 361–367, *April,* 1933.—X-ray analysis of nickel carbide, Ni_3C, prepared by carbonising nickel with carbon monoxide at 270–300° C., shows that the metal atoms are arranged in hexagonal close sphere-packing. The dimensions of unit cell of the metal-atom lattice are: $a = 2 \cdot 646$, $c = 4 \cdot 329$Å., $c : a = 1 \cdot 636$. No evidence is furnished of solubility of carbon in solid nickel or of extension of the region of homogeneity of the nickel carbide. The crystal structure of nickel carbide is of the *Einlagerung* type and is thus an exception to Hägg's rule for the structure of the hydrides, borides, carbides, etc., of transition elements. Probably this carbide is an unstable product and thus not directly comparable with the stable substances for which Hägg's rule was established. T. H. P.

2146. Crystal Structure of Methyl Urea. R. B. Corey and R. W. G. Wyckoff. *Zeits. f. Krist.* 85. 1–2. *pp.* 132–142, *March,* 1933. *In English.*—From powder photographs, rotation photographs and Laue photographs, methyl urea, CH_3NHNH_2CO, is found to be orthorhombic, the unit cell containing four molecules and having the dimensions $a = 6{\cdot}89$Å., $b = 6{\cdot}96$Å., and $c = 8 \cdot 45$Å. The atoms are in the general positions of space group V^4. Their exact positions have not been determined. A structure is found which explains the simple reflections but this is probably incorrect. J. T.

2147. Polymorphism of Paraffins. N. Yannaquis. *Comptes Rendus,* 196. *pp.* 784–787, *March* 13, 1933.—Microscopical investigations, with the following result: below solidification point, compounds uni-axial and positive; at point of transformation bi-axial and positive. F. I. G. R.

2148. Crystals of the Living Body. W. H. Bragg. *Roy. Inst., Proc.* 27. 4. *pp.* 606–624, 1933.—The account deals largely with the work of Astbury on the structure of silk, wool, hair, etc. Silk is largely composed of fibroin, which like other proteins is characterised by a chain-like arrangement of molecules. Hair, feathers, horn, etc., which are largely composed of keratin give similar photographs which are different from that of silk. Stretched hair, however, gives a picture similar to that of silk. This is explained by assuming that the molecular chain in all proteins is similar to that of silk, and that in the keratins the chain is somewhat crumpled up. Tension pulls the chain straight without breaking it. The work of Bernal on the crystal structure of the amino-acids, vitamins, etc., is also discussed. J. T.

2149. Effect of Foreign Matter in Solid Solution on the Stability of Crystals. P. Gaubert. *Comptes Rendus,* 196. *pp.* 942–944, *March* 27, 1933.—The effect of the presence of not more than 1 % of various dyes in crystals of hydrated phlorizin on their behaviour on heating as regards dehydration, refractive power, and cleavage is described. It is suggested that the presence of minute quantities of foreign substances may explain the varying behaviour of many minerals, *e.g.*, laumontite, of different origins. [See Abstracts 1694 and 2151 (1933).] C. A. S.

2150. Artificial Preparation of Regular Crystal Growths of Potash Alum. Marianna Schaskolsky and A. Schubnikow. *Zeits. f. Krist.* 85. 1–2. *pp.* 1–16, *March,* 1933.—Experiments on the formation of regular growths on ready-formed crystals of the alum are described.

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Besides the known parallel growths and twinnings according to the spinel law, a new mode of growth on the cube and octahedron faces and on their common edge (110) is observed. A method has been developed for the objective estimation of the growth laws by comparing the calculated probability of the given growth with the number of observed cases. All the possible cases of regular growths are derived theoretically for the alum. A representation of the mechanism of the agglomeration of crystals is given and Royer's theory of the epitaxy of crystals of different substances [*Soc. Min. France, Bull.* 51. *p.* 7, 1928] is extended to the growth of one and the same substances. T. H. P.

2151. Systematic Habit-Variation in Potassium Chlorate Crystals Produced by Dyes. H. E. Buckley and W. Cocker. *Zeits. f. Krist.* 85. 1–2. *pp.* 58–73, *March,* 1933.—Many dyestuffs (full lists given) partially inhibit growth on (011) planes of $KClO_3$: some of these dyes are many hundred times more powerful than the most potent inorganic ions. In the dye the group SO_3Na is the seat of the attaching power. F. I. G. R.

2152. Orientation of Crystals on Hydrargillite and on Twinned Calcite. L. Royer. *Comptes Rendus,* 196. *pp.* 709–710, *March* 6, **1933.**—The parameters of the base of crystals of hydrargillite are almost identical with those of muscovite [see Abstract 2406 (1930)]. Accordingly crystals that are oriented on mica are equally so on hydrargillite. The direction of orientation of crystals grown on a mechanically produced twin of calcite is the mirror image of that on the unaltered portion of the calcite crystal. [See Abstracts 2267 (1932) and 1693 (1933).] C. A. S.

2153. Alkylamine-Alums, and Other Alums with Organic Radicals. K. Wendekamm. *Zeits. f. Krist.* 85. 1–2. *pp.* 35–57, *March,* 1933.—Preparation of materials ; discussion of large crystals ; experiments upon a number of compounds such as $N(CH_3)_4Al$. F. I. G. R.

2154. Experiments on Cohesion. Part IV. Cleavage in Galena. H. Tertsch. *Zeits. f. Krist.* 85. 1–2. *pp.* 17–34, *March,* 1933.—Similar methods applied to galena show results almost identical with those for rock-salt as regards the effect of steady pressure (*Druckspaltung*) or a single blow (*Zugspaltung*), but the energy required for rupture by repeated small blows (*Schlagspaltung*) was only one-fourth that required in the case of rock-salt. Further in galena there is an entire absence of any (110) cleavage, a fact confirmed by comparison of the percussion figures which are entirely different. Samples from different localities behaved similarly. [For Part III see Abstract 2277 (1932).] C. A. S.

2155. Annealing of Plastically-Deformed Rock-Salt Crystals. N. A. Brilliantow and I. W. Obreimow. *Phys. Zeits. d. Sowjetunion,* 3. 1. *pp.* 83–91, 1933. *In English.*—A continuation of previous work [see Abstract 1991 (1927)]. Two results now emerge : (1) As annealing proceeds, the planes of principal strain are parallel to (011) ; (2) proportionality exists between the entire strain and its initial value. F. I. G. R.

2156. Simple Universal Camera for X-Ray Analysis. E. Sauter. *Zeits. f. Krist.* 85. 1–2. *pp.* 156–159, *March,* 1933.—A simple camera is described which may be used with either flat or cylindrical films for all the usual X-ray methods. In addition conical films may be employed, so that when the film is coaxial with the specimen axis all the layer lines may be obtained. J. T.

2157. Effect of Etching on the Relative Intensities of the Components of Double Laue Spots Obtained from a Quartz Crystal. M. Y. Colby and S. Harris. *Phys. Rev.* 43. *pp.* 562–563, *April* 1, 1933.—Laue patterns obtained from a quartz crystal of dimensions 100 × 6 × 2 mm. taken through the 2 mm. direction are given. One face of the crystal was highly polished and the other face was etched. The pattern obtained when the etched face of the crystal was next to the photographic film exhibited a weaker inner component for spots close to the origin; the pattern obtained when the etched face of the crystal was next to the source of X-rays exhibited a stronger inner component for spots close to the origin. The pattern obtained when the etched face of the crystal was next to the photographic film and the crystal was oscillating piezoelectrically along the direction of the long dimension showed no appreciable difference from the pattern obtained with the crystal in this same position when at rest. An explanation of the recent results obtained by J. M. Cork is offered. AUTHORS.

2158. Accurate Method of Determining Lattice Constants. V. Kunzl and J. Köppel. *Comptes Rendus,* 196. *pp.* 940–942, *March* 27, 1933.—An improvement of Pavelka's method of deducing with fair accuracy the lattice constant from observations with an inferior spectrograph is described, and is exemplified by application to quartz with a result differing by only 0·01 % from that obtained with a first class instrument. C. A. S.

See also Abstracts 2124, 2170, 2171, 2178, 2356, 2359, 2393, 2434, 2550, 2551, 2552, 2555, 2557, 2558, 2559, 2575, 2608, 2616, 2620, 2630.

DENSITY.

2159. A. Ångström's Total Immersion Hydrometer. P. F. Gaehr. *Rev. Sci. Instruments,* 4. *pp.* 138–141, *March,* 1933.—The present paper presents a study of this hydrometer and makes several suggestions: (1) Care must be exercised in the choice of ferrous material for the core and of the weight of that core. Permalloy is recommended. (2) Unless permalloy is used, a mixture of d.c. and a.c. is recommended for producing the magnetic pulls, only the d.c. being measured. (3) The equations are used to give hints for calibration and design. [See also Abstract 624 (1915).] AUTHOR.

See also Abstracts 2143, 2168, 2243, 2398, 2466, 2502, 2560.

DIFFUSION AND OSMOSIS.

2160. Functional Equation of Eddy Diffusion. O. F. T. Roberts. *Roy. Meteorolog. Soc., Mem.* 4. *pp.* 85–97, *April,* 1933.—The paper is mathematical throughout and not suitable for abstracting. The principal conclusion is that when the density distribution due to scattering satisfies a certain functional (integral) equation, then the mean square distance of matter scattered from a plane source increases proportionally to the time. J. H. A.

2161. Diffusion of Gas at Low Pressures. J. Rotblat. *Acta Physica Polonica,* 2. 1. *pp.* 143–155, 1933. *French Abstract.*—The diffusion of hydrogen, oxygen, argon, krypton and xenon at low pressures is studied in relation to the production of high vacua by cooling part of the system in liquid air, whereby the condensing mercury vapour (from the pumps) entrains part of the gas. If P is the mercury vapour pressure and p_1 and p_2 are the gas pressures at the two ends of the tube, $\log(p_2/p_1)$ is an approximately linear function of P and of the tube diameter; this is in accordance with Knudsen's law, which, however, does not take into account the observed variation of $\log(p_2/p_1)/P$ with the mean gas pressure, and requires therefore some modification. With increase of P or of the mean gas pressure $\log(p_2/p_1)/P$ in general increases, but the type of curve obtained varies with the nature of the gas ; the increase is greatest with the lightest gases and in the case of krypton and xenon passes through a minimum. H. F. G.

2162. Osmotic Pressure of Nitrocellulose Solutions. J. Grard. *Comptes Rendus,* 196. *pp.* 773–775, *March* 13, 1933.—Specimens of nitrocellulose were heated with water in an autoclave at 130° C. for 4, 8, 12, 16, and 20 hr., and were then dissolved in acetone. The osmotic pressures of the solutions (1 %) were a linear function of the duration of digestion ; the unhydrolysed material had a molecular weight of about 50,000. The viscosities of the solutions increased to a limiting value. H. F. G.

See also Abstracts 2120, 2225.

ELASTICITY AND PLASTICITY.

2163. Pure Bending of Long, Thin-Walled Tubes. E. Chwalla. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 48–53, *Feb.,* 1933.—A reprint of the first portion of a previous paper [see Abstract 3690 (1931)]. J. P. A.

2164. Stresses in Cylindrical and Conical Thin Walls. C. M. Moir. *Roy. Techn. Coll. Glasgow, J.* 3. *pp.* 137–162, *Jan.,* 1933.—The manner by which elastic theory may be applied to a wide range of practical problems connected with the stresses in thin walls of cylindrical or conical form, is explained. Applications are facilitated by tables given in the paper, and examples are worked out. J. P. A.

2165. Calculation of Stresses in Braced Frameworks. R. V. Southwell. *Roy. Soc., Proc.* 139. *pp.* 475–507, *March* 3, 1933.—A summary is first given of the calculation of stresses in braced frameworks by the author's analytical method, in which the conception of tension coefficients is employed. By an application of this method, exact solutions are found for the problem of a tubular framework representative of a rigid airship hull. The high order of redundancy of such a framework excludes conventional methods, but in this paper a number of solutions are obtained by synthesis from type solutions which are themselves fully investigated. The " device of the separate panel," an approximation used when some of the constituent members are incapable of supporting compression, is shown to be satisfactory when several members are inoperative. A procedure for calculation in such cases of pseudo-redundancy is outlined. J. P. A.

2166. Tightness of Teeth. J. L. Synge. *Roy. Soc., Phil. Trans.* 231. *pp.* 435–477, *March* 20, 1933.—The problem of the tightness of teeth is considered as a special case of the equilibrium of a thin, homogeneous, isotropic, incompressible elastic membrane, confined between, and attached to two rigid bodies, the tooth and the socket. This general problem is analysed tensorially. Applications to idealised forms of tooth are then made to determine the pressures in the periodontal membrane ; the displacements when forces are applied to the crown of the tooth ; and the position of the centre of rotation of the tooth. The closest approximation taken is that of an upper central tooth whose root is a right circular cone ; while the rigidity of the membrane is assumed to be that of rubber. Detailed results are represented graphically ; and the minuteness of the calculated displacements is evidence that the tightness is in this way adequately explained. J. P. A.

2167. Pressure-Volume-Temperature Relations of Fifteen Liquids. P. W. Bridgman. *Am. Acad., Proc.* 68. 1. *pp.* 1–25, *March,* 1933.—The changes of volume up to 12,000 kg./cm^2. pressure, and from 0° to 95° C., are investigated in the following 15 liquids, (*a*) triethanolamine, (*b*) nine alkyl halides, and (*c*) five isomers of octanol. The sylphon method [see Abstract 1819 (1932)] is employed. From measurements on (*a*) the OH group again appears to decrease compressibility, as in glycerin, while from (*b*) it appears that the effect of a halogen in diminishing compressibility is roughly equal to that of an OH group. Among these nine halides, in the groups containing a common halogen, the compressibility decreases in passing from propyl to butyl to amyl groups, while in sets containing a common alkyl group the compressibility decreases as the atomic weight of the halogen increases. As universally found, the thermal expansion decreases with increasing pressure. The additional molecular volume required by a CH_2 group depends greatly on the pressure, becoming less at higher pressures. The differences between the volumes occupied by the halogens in these compounds appears several fold greater than those calculable from X-ray observations on solids. Practically no deductions can be drawn from the observations on the isomers (*c*). J. P. A.

2168. Isotherms for Helium at Low Temperature and High Pressure. E. Buchmann. *Zeits. f. phys. Chem.* 163. *Abt. A.* 3–4. *pp.* 461–468, *March,* 1933.—The specific volume of helium gas has been measured at a number of temperatures from 13·5 to 20·4° K., using pressures up to 1800 kg./cm^2. at those temperatures where the fusion does not impose an earlier limit. The density of the gas at 20° K. and the highest pressure is some 12·5 times that given by the simple gas laws. J. H. A.

2169. Temperature Coefficient of Elastic Moduli of Metals and Alloys. G. H. Keulegan and M. R. Houseman. *Bureau of Standards, J. of Research,* 10. *pp.* 289–320, *March,* 1933.—The temperature coefficients of the modulus of rigidity and of Young's modulus of elasticity of 31 alloys and metals have been determined in the temperature range − 50° to + 50° C. These were selected on the basis of their possible use as elastic elements for aircraft and other instruments. In most cases the temperature coefficients were determined with the metal in the condition of heat treatment or cold work most suitable for its use as an elastic element and also in the annealed condition. The coefficient of each modulus at 0° C., the ratio of the coefficient at + 25° to that at − 25° C., the composition and the heat treatment or cold work are given for each sample. The temperature coefficient of Poisson's ratio and the significance of the differences in the two coefficients for a given material are discussed. AUTHORS.

2170. Rigidity of the Multiple Crystal. W. Kuntze. *Zeits. f. Physik,* 81. 1–2. *pp.* 80–83, *March* 3, 1933.—From rigidity and extension researches on bodies of dissimilar constitution, which produce a spatial tension condition, the different behaviour of polycrystalline industrial material in contradistinction to the single crystal is demonstrated. The results lead to the conclusion that the rigidity hypotheses of the elastic continua should not be transferred to polycrystalline materials without simultaneous consideration of the disruption cohesion. J. J. S.

2171. Plasticity and Hardness of Crystals of Alkali Metal Halides. K. Przibram. *Akad. Wiss. Wien, Ber.* 141. 2(*a*). 9–10. *pp.* 645–649, 1932.—The validity of the empirical plasticity law found earlier for rock-salt [see Abstract 3550 (1932)] has been confirmed by numerous new experiments. The law holds also for potassium chloride and bromide. Measurements of the Brinell hardness of the three salts reveal, *inter alia*, strengthening by pressure and weakening by recrystallisation. A particularly deep blue natural specimen of salt showed appreciably greater hardness than the other samples examined. T. H. P.

2172. Nature of "Yield-Value." G. W. S. Blair. *Physics*, 4. *pp.* 113–118, *March*, 1933.—The problem of the flow of materials at stresses far below their normal yield-values is discussed, and it is pointed out that the sharpness with which yield-values can be measured depends on the grouping of the relaxation times for the different strains set up within the material, an uneven distribution making for a sharper definition. Any sharp and drastic change in the relaxation time or the system as a whole may justifiably be said to constitute a yield-value, the question as to which of these points is actually taken as the yield-value depending on the conditions of the experiment. These considerations are reinforced by a discussion of the results (to date) of certain experiments on flour doughs, and it is claimed that flour dough is a peculiarly suitable material for such investigations. A new rapid method of studying flow in flour doughs, recently described in the literature, is discussed. The dangers of classifying materials in hard-and-fast rheological divisions is emphasised, while it is pointed out that for practical purposes, and given adequate safeguards, such classifications may be extremely useful. [See also Abstract 869 (1933).] AUTHOR.

2173. Viscosity, Elasticity and Plastic Strength of Flour Dough. Part II. R. K. Schofield and G. W. S. Blair. *Roy. Soc., Proc.* 139. *pp.* 557–566, *March* 3, 1933.—Continuing previous work [see Abstract 869 (1933)] the dependence of the viscosity of a flour dough on the shear strain as well as on the shear stress, is demonstrated by observations on cylinders of unyeasted dough allowed to elongate under their own weight. In this way viscosities are determined which are of the same order as those derived in the previous paper from values of the relaxation time. J. P. A.

2174. Theory of Visco-Elasticity. J. H. C. Thompson. *Roy. Soc., Phil. Trans.* 231. *pp.* 339–407, *March* 13, 1933.—An historical account is followed by a thermodynamical investigation wherein, by a complete application of the principle of virtual work to a strained or straining imperfectly elastic solid, a general theory of visco-elasticity is developed. A visco-elastic body is characterised by the properties (1) when a change of geometrical configuration is made indefinitely slowly, the change is reversible and there is no dissipation of energy, and (2) when the change is made at finite speed, it is irreversible, and dissipation occurs. In the course of the theory, modifications in the stress-strain relations due to thermo-elastic effects are worked out. A number of general theorems are proved. A critical number for a visco-elastic solid is defined, such that if it exceeds unity, free elastic oscillations are impossible, while if it is less than unity, the free vibration is due to the superposition of damped harmonic oscillations and aperiodic motions. For solids of simple shape there is a critical size with similar properties. The theory is illustrated by examples on longitudinal and torsional vibrations of thin, isotropic cylinders, and problems of forced oscillations are analysed. A hysteresis loop for a cycle of changes is constructed. J. P. A.

2175. Plastic Properties of Asphaltic Bitumen. R. N. J. Saal and G. Koens. *Petroleum Technol. J.* 19. *pp.* 176–212, *March*, 1933.—By means of a capillary and a rotation viscometer, the viscosities of the most common types of asphaltic bitumens are determined at temperatures mainly below the ring and ball temperature, and in the neighbourhood of 200 penetration. The determinations are complicated by the coexistence of elasticity, plasticity and thixotropy or diminution of viscosity at constant shear stress. Relations between viscosities, penetrations and ductilities are worked out, and the influence of pressure determined. When the shear stress is of the order 100,000 dynes per cm.^{2}, asphaltic bitumens have about the same viscosities at the ring and ball temperature. It appears that the cause of plasticity lies chiefly with the maltenes and not with the asphaltenes in the mixtures. J. P. A.

2176. Mechanism of Plastic Deformation. A. W. Stepanow. *Zeits. f. Physik*, 81. 7–8. *pp.* 560–564, *March* 30, 1933.—Work done during plastic deformation of a crystalline substance is largely transformed to heat. In a rock-salt crystal the plastic deformations are confined to slip-zones of thickness about 10^{-6} cm., and the average deformation energy per cm.^{2} of slip surface is about 10^{-3} cal., a quantity capable of raising the temperature of a slip-zone by 2500° C. Such a high localised temperature would probably result in a temporary dislocation of the neighbouring space-lattice, a distortion from which the properties of the plastically deformed substance might result. To test this hypothesis, changes in electrical conductivity of a small rock-salt crystal are observed, while the crystal is plastically deformed. Since the conductivity in the undeformed condition varies in the ratio $10^{16}:1$ in a range of 800° C., local changes of temperature should be detected. A sudden increase of conductivity, of the order of magnitude desired, is found, and reasons are given for rejecting piezoelectric effects as the cause. Other confirmatory evidence on behalf of the hypothesis is alluded to. J. P. A.

2177. Rate of Deformation of a Loaded Bar. P. Melchior. *Phys. Zeits.* 34. *pp.* 220–222, *March* 1, 1933.—An amplification and criticism of the work of H. Deutler [see Abstract 2688 (1932)]. Variation in deformation velocity of a loaded specimen may be explained from the dynamics of the loading mechanism. Deutler's conclusions regarding a tensile strength for infinitely slow loading, are criticised, and his materials, iron and copper, are considered unsuitable; zinc and magnesium are suggested. **H. Deutler,** replying, rediscusses the effect of the loading mechanism and the question of tensile strength. Zinc and magnesium are unsuitable materials owing to the risk of alteration of crystal size during the experiment. J. P. A.

2178. Connection between Distortion and Recrystallisation Capacity in Plastic Deformation of Metals. W. G. Burgers and J. J. A. P. van Amstel. *Zeits. f. Physik*, 81. 1–2. *pp.* 43–65, *March* 3, 1933.—The results obtained by various investigators bearing on the connection between distortion and recrystallisation capacity are discussed. In the case of Al the distortion under tension or compression with uniform stretching or shortening according to some experimenters is conditioned to a first approximation only by the total sliding and is not essentially influenced by a distribution of the slipping over two slide planes. Thus for Al the possibility of the occurrence of a different recrystallisation capacity with the same distortion on compression is given. Actually recrystallisation experiments with stretched single Al crystals indicate that the recrystallisation capacity, measured by the number of the crystallites formed, with equal total sliding is the smaller the more slipping surfaces have taken part in the deformation. Thus the results of experiment are apparently contradictory and the authors bring forward a possible explanation by suggesting the occurrence of a definite predominant orientation with Al single crystals produced by recrystallisation from feebly stretched polycrystalline original material. J. J. S.

2179. Photoelasticity. M. Biot. *Ann. Soc. Sci. de Bruxelles,* **53.** *pp.* **13–15,** *March* **13, 1933.**—A photographic method of recording the strains exhibited in photoelastic apparatus is described. Bakelite models can be used in the experiments, which consist of taking kinematograph records of the changes produced in the fringes when the nicols are rotated. The method of evaluating the strains is briefly indicated. W. D. W.

See also Abstracts 2116, 2155, 2181, 2242, 2295, 2482, 2550, 2551, 2552, 2553, 2554.

GRAVITATION.

2180. Modernisation of Pendulum Apparatus. K. Wold and G. Jelstrup. *Bull. Géodésique, No.* 33. *pp.* 11–25, *Jan.–Feb.–March,* **1932.** *In English.*—A reconstruction of two old v. Sterneck pendulums of the Norges Geografiske Opmaaling, with the object of enabling them to be used in the observation of relative gravity with modern precision is described. The pendulums are of bronze and the principal improvement consisted in the provision of a containing vessel of glass which could be evacuated and the residual air maintained at a temperature constant within a small interval by means of a heating element and electro-magnetic relay. In addition, an apparatus consisting of a photoelectric cell, 3-stage amplifier and chronograph recorder was provided to substitute automatic for the former visual recording of the oscillation of the pendulums. The chronograph was connected to a long-wave radio receiver, also equipped with a relay, for picking up the time signals from Lafayette, Rugby and Nauen, and so recording these signals simultaneously with the pendulum oscillations. Full description of all the devices used is given. On test, the apparatus gave excellent results with a single two hours' swing between successive time signals, *i.e.*, about 15,000 oscillations of each of the two pendulums. With a pressure of about 50 mm. in the container, the amplitude of the pendulum diminished only about 1 mm. during a two hours' swing. A specimen observation and computation series is given. The cost of modernising the apparatus was about $350, and the radio registering outfit cost an equal amount. E. L. J.

See also Abstracts 2282, 2302.

HYDRODYNAMICS AND AERODYNAMICS.

2181. Calculation Relating to Cylindrical Vessels for Storing Fluids, Subjected to Wind Pressure. K. Girkmann. *Akad. Wiss. Wien, Ber.* 141. 2a. 9–10. *pp.* 651–672, 1932.—A mathematical theory is developed, enabling the stresses produced in a vertical cylindrical structure, subjected to wind pressure, to be calculated. J. S. G. T.

2182. Resistance Experienced by a Body Moving in a Fluid Towards its Free Surface. T. Sakai, Y. Husimi and M. Hatoyama. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 4–11, *Jan.,* 1933. *In English.*—The two-dimensional case is considered of an infinitely long cylinder, with axis horizontal, rising vertically with uniform velocity through an incompressible perfect fluid. On the assumption that the body rises from an infinite depth, the shape of the free surface is given and also the force acting on unit length of the cylinder. G. G. S.

2183. Moment of the Force Acting on a Flat Plate Placed in a Stream between Two Parallel Walls. S. Tomotika. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 94. *pp.* 357–393, *March*, 1933. *In English.*—In continuation of previous work [see Abstract 883 (1933)]. Blasius's formula is used to compute the moment, M, of the force acting on a flat plate placed obliquely in a steady irrotational continuous stream of an incompressible perfect fluid bounded by two parallel walls, the midpoint of the plate lying on the axis of the channel. Approximate expressions for M are developed as power series of $2a/D$, where a denotes the breadth of the plate and D the width of the channel. Numerical values of M/M_0, M_0 denoting the moment in the absence of the channel walls, are calculated when the angle of inclination of the plate to the direction of flow (β) is 45°. Curves in which values of M/M_0 are plotted against values of $2a/D$ are drawn for values of β equal to 10°, 20°, 30°, 45° and 60°. J. S. G. T.

2184. Impulse Theorem of Hydrodynamics for Movable Walls and Calculation of the Forces of Reaction of the Liquid. W. Müller. *Ann. d. Physik*, 16. 5. *pp.* 489–512, *March*, 1933.—Purely mathematical. General expressions, based upon the impulse theorem, are developed for the reaction forces exerted by a liquid upon the adjacent walls when the latter are subjected to translatory and rotatory motion. The relationship with formulæ employed technically, such as those of Joukovsky and Euler, is demonstrated. The case of motion in an infinite ideal fluid is considered in detail, together with the application of the equations to determination of the force acting on a rotating plate of infinite length. H. F. G.

2185. Movement in a Viscous Liquid Completely Filling a Space. J. Leray. *Comptes Rendus*, 196. *pp.* 527–529, *Feb.* 20, 1933.—Purely mathematical. H. F. G.

2186. Movement Set Up in a Viscous Fluid by Rotation of a Cylinder. M. Luntz and P. Schwarz. *Comptes Rendus*, 196. *pp.* 894–896, *March* 27, 1933.—A solution is given for the movement in the surface of a liquid, confined by two planes of which the upper is the free surface, in which a cylinder rotates at constant angular velocity. The equation obtained agrees very closely with results obtained chronophotographically. [See following Abstract.] H. F. G.

2187. Alternate Annular Coaxial Eddies and Asymmetric Phenomena Associated with Rotation of a Cylinder in a Viscous Fluid. M. Luntz and P. Schwarz. *Comptes Rendus*, 196. *pp.* 1080–1082, *April* 10, 1933.—The character of the motion of a viscous fluid in which a cylinder is caused to rotate about its axis is investigated experimentally for different rates of rotation of the cylinder. [See preceding Abstract.] J. S. G. T.

2188. Movement and Wake, in Three Dimensions, of a Solid Body in a Fluid. F. Vasilesco. *Comptes Rendus*, 196. *pp.* 896–898, *March* 27, 1933.—An account is given of a method of studying the three-dimensional movement of a solid of revolution immersed in an incompressible fluid. H. F. G.

2189. Slow Rotation of an Anchor Ring in an Infinite Viscous Liquid. F. E. Relton. *Phil. Mag.* 15. *pp.* 840–848, *April*, 1933.—The slow rotation of an anchor ring about its axis of figure in a viscous liquid is discussed mathematically. The path of each particle of the liquid is taken as a circle and the analysis is conducted in orthogonal curvilinear ring co-ordinates. Solutions, depending on Laplace's equation for the vector velocity, are obtained in terms of associated Legendre functions of degree 1/2 and integral order. An expression for the resisting couple is derived, and numerical illustrations and an approximate formula are given. [See also Abstract 1746 (1931).] J. S. G. T.

2190. Loss of Flow in Curved Channels. W. Spalding. *V.D.I.* 77. *pp.* 143–148, *Feb.* 11, 1933.—Nippert's work on bends of 90° and 180° has been extended to other angles, *viz.*, 45°, 67°, 112·5°, and 135°, and to channels of increasing and decreasing cross-sectional area. The results confirm that in curved channels having the same cross-sectional area at the inlet and outlet the loss may be reduced by increasing the cross-section at the curve. H. F. G.

2191. Breakdown of Streamline Motion at the Higher Critical Velocity in Pipes of Circular Cross-Section. A. H. Gibson. *Phil. Mag.* 15. *pp.* 637–647, *March*, 1933.—The critical velocity of flow in cylindrical pipes of various diameters has been determined, by the colour band method, as a function of the distance of the band from the axis of the pipe. Turbulent motion first occurs at a distance from the axis equal to about 0·6 of the radius of the pipe; this factor diminishes somewhat as the radius of the pipe is increased. Discussion of the phenomenon of critical velocity suggests that breakdown is related to the rate of variation of energy across a diameter of the pipe. H. F. G.

2192. Viscous Flow Through Pipes with Cores. N. A. V. Piercy, M. S. Hooper and H. F. Winny. *Phil. Mag.* 15. *pp.* 647–676, *March*, 1933.—The theory of viscous flow through long eccentric annuli is considered. Lateral disturbances of flow are likely to be experienced in experimental work with annular pipes, owing to the difficulty of avoiding slight eccentricity. Up to certain values of the Reynolds number, however, rectilinear flow is established in concentric annuli with a reasonable stilling length of channel. Two critical speeds are observed; the first, in wide annuli, is attributable to the core, and the second to the wall of the pipe. A core begins to delay the development of turbulence only when its diameter exceeds 0·5 that of the pipe. A mathematical solution is given for steady flow through a channel bounded by confocal elliptical walls, particular attention being given to the limiting case of a flat strip as core; comparing this case with that of a circular core of equal resistance in a circular pipe of equal cross-sectional area, it is found that the ratio of the contour of the flat strip to that of the core, for equal discharge, is greater than unity but less than $4/\pi$ in streamline flow. This difference is important also in turbulent flow. H. F. G.

2193. Transitory Régimes. E. Crausse and J. Baubiac. *Comptes Rendus*, 196. *pp.* 602–603, *Feb.* 27, 1933.—The apparatus described previously [see Abstract 1862 (1933)] has been applied to study of the transitory régimes corresponding with the movement, from rest, of a viscous liquid about a cylindrical obstacle placed between a reservoir and a variable outlet. The Reynolds number corresponding with the permanent régime is established the more rapidly, the higher is the viscosity. The time required for the velocity to rise to a constant fraction of that corresponding with the permanent régime decreases, at first very rapidly, with increase of the Reynolds number. H. F. G.

2194. Transitory Régimes in a Cylindrical Tube Enclosing an Obstacle. E. Crausse and J. Baubiac. *Comptes Rendus,* 196. *pp.* 751–753, *March* 13, 1933.—The case of a truncated cone placed centrally and with its base facing the direction of flow, is studied experimentally. H. F. G.

2195. Recent Results Relating to the Investigation of Turbulence. L. Prandtl. *V.D.I.* 77. *pp.* 105–114, *Feb.* 4, 1933.—Recent work relating to turbulent fluid motion is briefly reviewed, and a Bibliography is appended. J. S. G. T.

2196. Theory of Turbulence. F. Magyar and F. Kracmar. *Phys. Zeits.* 34. *pp.* 241–245, *March* 15, 1933.—The development of turbulence in fluid motion over an infinite plane, between two plane-parallel plates and in a circular-cylindrical channel is discussed mathematically, attention being directed, more especially, to what occurs in the boundary layer. J. S. G. T.

KINETIC THEORY OF MATTER.

2197. Effect of Heat Flow on Brownian Movement. M. Satô. *Zeits. f. Physik,* 80. 11–12. *pp.* 822–826, *Feb.* 23, 1933.—A mathematical calculation based on the kinetic theory of gases to determine the effect of heat flow on the Brownian movement of a particle of spherical shape. The calculation is based on Einstein's distribution function for a gas between two horizontal parallel plates at different temperatures [see Abstract 1414 (1923)]. The mean total change of one component of velocity of the particle due to molecular bombardment is calculated from an integral given by F. Zeilinger [see Abstract 27 (1925)]. The result obtained is that in a gas at low pressure, the magnitude of the effect is of an observable character, but that in a gas at normal pressure it is too small to be observed. T. B.

See also Abstracts 2204, 2225, 2389, 2473, 2579, 2624.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

2198. Magnetic Method for Measurement of Thicknesses. P. Bricout. *Comptes Rendus,* 196. *pp.* 689–691, *March* 6, 1933.—A continuous and automatic method of measuring the thickness of thin plates and foil, or the diameter of fine wires, is described for use where the magnetic permeability of the material to be measured is practically equal to that of air. Use is made of a transformer of which the iron core is divided into three parts A, B and C. The primary coil is wound on A and is connected to a steady source of alternating current; B and C each carry a secondary coil. Small gaps separate B and C from A, the value of that between A and C being fixed by the interposition of a strip of non-magnetic material, while that between A and B is determined by the specimen to be measured. Variations in the thickness of the specimen set up variations in the e.m.f. of the secondary coil wound on B, the latter being compared with the e.m.f. of the other secondary coil by means of a special galvanometer calibrated directly in a scale of thicknesses. The sensitivity of the method is such that variations of thickness of the order of $0 \cdot 1 \mu$ may be detected. The magnetic attraction between A and B exerts on the specimen a definite measuring pressure proportional to its thickness. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

2199. Tangential Polar or Pedal Coordinates, and their Application. M. Jacob. *R.G.E.* 33. *pp.* 403–411, *April* 1, 1933.—The author first defines "pedal" coordinates as being related to polar coordinates in the same way as ordinary tangential coordinates are related to cartesians, next discusses some of their properties, and then establishes transformation formulæ from equations in pedal coordinates into equations in classical coordinates, including inverse transformations. These generalisations are followed by examples of applications to equations of the familiar curves and to the utility of pedal coordinates in physical problems, especially those relating to vibrations. H. H. Ho.

2200. Interpolation without Differences. R. T. A. Innes. *Observatory,* 56. *pp.* 89–91, *March,* 1933.—Reference is made to interpolation, a branch of computation much used by astronomers, which can be adapted to machine working. Formerly a table of differences was constructed and a table of interpolating coefficients for each case obtained. Jordan obtained a formula involving central differences only to simplify the procedure. Aitken dispenses with differences and uses an iterative process of quadratic proportional parts on the linear interpolates. An example of this process is supplied in the paper. R. S. R.

2201. Nomogram with Circular Guides. S. Gradstein. *Zeits. f. Instrumentenk.* 53. *pp.* 172–175, *April,* 1933.—In most cases nomograms are traced by so-called alignment tables, three points being obtained along a line which serves as an indicator. A general property possessed by a circle is that this line can be displaced without changing the diagram. The nomogram with cross-arms is not only of theoretical interest as shown by d'Ocagne, but for practical purposes it has useful applications. Based on the law that if two chords of a circle intersect, the product of the two parts of each chord is constant, several applications are discussed. This is shown to be of service in the conversion of different systems of logarithms, the sine law in triangles, Snell's law of refraction, the sine and tangent conditions in optics, obtaining geometrical means, and in the weights of pipes of various dimensions. R. S. R.

2202. Statistical Hypotheses. J. Neyman and E. S. Pearson. *Roy. Soc., Phil. Trans.* 231. *pp.* 289–337, *Feb.* 16, 1933.—Introduces a new basis for choosing among criteria suitable for testing any given statistical hypothesis H_0 with regard to an alternative H_1. If θ_1 and θ_2 be two such possible criteria and if in using them there is the same chance ϵ of rejecting H_0 when it is in fact true, we should choose that one of the two which assures the minimum chance of accepting H_0 when the true hypothesis is H_1. Starting from this point of view, since the choice of a criterion is equivalent to the choice of a critical region in multiple space, it is possible to introduce the conception of the best critical region with regard to the alternative hypothesis H_1. This is the region the use of which, for a fixed value of ϵ, assures the minimum chance of accepting H_0 when the true hypothesis is H_1. The criterion, based on the best critical region, may be referred to as the most efficient criterion with regard to the alternative H_1. The choice of the most efficient criterion, or of the best critical region, is equivalent to the solution of a problem in the calculus of variations. The solution of this problem for the case of a simple hypothesis is given ; for the case where the hypothesis tested is composite, the solution of a further problem is required; this consists in determining what has been called a region similar to the simple space with regard to a parameter. This subsidiary problem has as yet only been solved under certain limiting conditions ; this restricts the generality of the solution given to the problem of the best critical region for testing composite hypotheses. An important case arises, when the best critical regions are identical with regard to a certain class of alternatives, which may be considered to include all admissible hypotheses. In this case (shown by several examples not to be an uncommon one) unless we are in a position to assign precise measures of *à priori* probability to the simple hypotheses contained in the composite H_0, it appears that no more efficient test than that given by the best critical region can be devised. The question of the choice of a " good critical region " for testing a hypothesis when there is no common best critical region with regard to every alternative admissible hypothesis, remains open. It is, however, shown that the critical region based on the principle of likelihood satisfies our intuitive requirements of a " good critical region." Illustrations worked out for several important problems ; more of these are to follow. A. D.

2203. Method of Least Squares. A. S. Eddington. *Phys. Soc., Proc.* 45. *pp.* 271–282 ; *Disc.*, 282–287, *March* 1, **1933.**—In inferring the value of a physical quantity x from observations some risk must be accepted. It is therefore presumed that the investigator has made up his mind how much risk he will take, and desires the closest possible limits—the narrowest range of values of x—that he can adopt without exceeding this risk. The aim is to furnish a concise treatment of combination of observations on this basis, which it is hoped may be found useful in clearing up common misconceptions. Stress is laid on the fact that the method of least squares is justified without the assumption of a Gaussian error law of the observations. Most of the paper deals with quite elementary points, but it ends with a discussion of more difficult questions which arise in inferring the mean square error of observation from the residuals. AUTHOR.

2204. Probability and the Exponential Laws of Physics. M. C. Holmes. *Frank. Inst., J.* 215. *pp.* 281–285, *March*, **1933.**—The derivation of the exponential laws of physics, of the general form $I = I_0e^{-ax}$, from Poisson's law of probability is briefly discussed, and illustrated by reference to molecular free paths, radioactive decay and the absorption of radiation by matter. J. S. G. T.

• 2205. Electro-Mechanical Determinant Machine. A. Weygandt. *Zeits. f. Instrumentenk.* 53. *pp.* 114–121, *March*, **1933.**—For a large number of mathematical, physical and technical problems a system of linear equations is obtained for the unknowns and many numerical and graphical methods are available for their solution. In many cases, however, this depends upon the personal dexterity and perseverance of the computer. For a large number of unknowns a completely general and circumstantial procedure for the solution of the equations leads to the determinant theory. For more than two determinants, however, the use of a calculating machine is very wearisome. The machine described avoids difficulties due to toothed wheels, friction and inertia by employing electrical action. A multiplication action is constructed with telephone components and relays operated by two keys, and successive factors can be multiplied. This action is used for the complete automatic calculation of determinants in which by electrical regulation the inserted coefficients are brought as it were to the stock, little by little, in the sense of a numerical series of multiplications, and the partial products are added into a working whole. R. S. R.

2206. Weber-Kern Planimeter. G. Grüss. *Zeits. f. Instrumentenk.* 53. *pp.* 129–131, *March,* 1933.—Description of the construction and the mode of use of the Weber-Kern planimeter ; revision (mathematical) of the theory of the instrument, with suggested amendments. A. D.

See also Abstract 2625.

MECHANICS, CLASSICAL.

2207. Many-Valued Potential Functions. R. Wavre. *Arch. des Sciences,* 14. *pp.* 363–373, *Nov.–Dec.,* 1932.—An investigation of the potential function due to an arbitrary distribution, R, of attracting matter is given. The potential in two regions of R will belong to the same many-valued harmonic function provided it is possible to go from one region to the other along a path such that the algebraic sum of the changes in the value of the function on traversing the various bounding surfaces of the matter composing R, is zero. The theory is applied to various distributions of matter of simple form. G. C. McV.

2208. Applications of the Theorem of Three Moments. V. Belfield. *Phil. Mag.* 15. *pp.* 562–574, *March,* 1933.—The solution of problems relating to the stresses in certain types of framework, particularly those which contain rigid joints, is described, the theorem of three moments enabling equations of greater generality to be solved and written down at once. A proof of the theorem is included, the applications being to the " portal frame structure " and to the deflection of beams under simple types of loading. H. H. Ho.

2209. Lattice Regions and their Application in Dynamics. C. H. Dix. *Tohoku Math. J.* 36. *pp.* 324–345, *Jan.,* 1933. *In English.*—A theory of lattice regions, that is, of sets of discrete points, and of functions of lattice points is developed on the analogy of classical analysis. This theory is then applied to the dynamics of discontinuous motion, and the treatment is generalised to deal with the idea of a non-uniformly flowing time. A. J. McC.

2210. Displacement of an Ennuple and a New Interpretation of Ricci's Coefficients of Rotation. P. Dienes. *Accad. Lincei, Atti,* 17. *pp.* 119–122, *Jan.* 22, 1933.—Gives a kind of generalisation to Riemannian space of the motion of a rigid system of axes in ordinary space. A. J. McC.

2211. Analytical Nature of Solutions of Canonical Systems Integrable by Quadratures. G. Lampariello. *Accad. Lincei, Atti,* 17. *pp.* 129–135, *Jan.* 22, 1933.—Discusses the analytic character of the solutions, under certain conditions, of the canonical equations of motion of periodic dynamical systems. A. J. McC.

2212. Geometrical Interpretation of Mechanical Systems. G. Vranceanu. *Accad. Lincei, Atti,* 17. *pp.* 135–140, *Jan.* 22, 1933.—The motion of a dynamical system of n degrees of freedom, holonomic or non-holonomic, can be represented geometrically in a non-holonomic space of $(n + 1)$ dimensions, and the equations of motion can be expressed in a form invariant with respect to transformations of the co-ordinates involving the time. A. J. McC.

2213. Differential Equations of Ballistics. C. A. Clemmow. *Roy. Soc., Phil. Trans.* 231. *pp.* 263–288, *Jan.* 31, 1933.—A mathematical discussion of the various types of differential equation which arise in internal ballistics when the simple assumptions of rate-of-burning proportional to pressure or of non-resisted motion are discarded. The equations are shown to be mostly irreducible, non-linear and of the second order, but in the case of a propellant shape preserving a constant surface area during burning they can be reduced to the first order and finally transformed into equations of the Briot-Bouquet type. Most of the first order equations of internal ballistics can be written in the form

$$dy/dx = P_0 + P_1 y + P_2 y^2 + P_3 y^3$$

where P_0, P_1, P_2, etc., are functions of x and, in the case where no terms beyond y^3 occur, the equation can be transformed into the "canonical" form

$$dy/dx = y^3 + P(x)$$

A method of solution of this type of equation is suggested as a power series in y. The second order equations arising when the propellant shape is other than that of a constant burning surface are usually found to be irreducible. S. G. B.

2214. Statistics of Continuous Systems and Temporal Course of Physical Processes. M. Leontowitsch. *Phys. Zeits. d. Sowjetunion,* 3. 1. *pp.* 35–63, 1933. *In German.*—The probability of a function is defined, the case of a Gaussian distribution being more especially discussed, and the results are applied to the development of a system of statistical thermodynamics based on a theory of fluctuations. J. S. G. T.

2215. Gyroscopic Tops and Combinations. J. G. Gray. *Roy. Inst., Proc.* 27. 4. *pp.* 548–567, 1933.—Description of a set of gyroscopic tops and combinations devised by the author, for demonstrating the properties of the gyroscope and for illustrating technique suitable for rendering the gyroscope available for use in the production of stabilisers, of artificial horizons, and of steering devices for moving vehicles, such as ships, airships, and aeroplanes. A. D.

See also Abstracts 2216, 2225, 2252, 2498, 2501, 2520.

MECHANICS, QUANTUM.

2216. Lagrangian in Quantum Mechanics. P. A. M. Dirac. *Phys. Zeits. d. Sowjetunion,* 3. 1. *pp.* 64–72, 1933. *In English.*—A system of quantum mechanics, based on the *ideas* of classical Lagrangian theory, is developed. J. S. G. T.

2217. Kowalewski's Top in Quantum Mechanics. O. Laporte. *Phys. Rev.* 43. *pp.* 548–551, *April* 1, 1933.—It is well known that in classical mechanics algebraic integrals of the top equations only exist in the cases of Euler (asymmetric top, no electric moment), of Lagrange (symmetric top, electric moment parallel to the axis of figure) and of Kowalewski. The latter case is that of a symmetric top whose two equal moments of inertia are twice as large as the third (A = B = 2C) with an electric moment perpendicular to the axis of figure. The quantum mechanical analogue to Euler's and Lagrange's cases being well known, Kowalewski's case was tried. If θ, ψ, ϕ are the Euler angles, $Q_{\mathrm{I}} = Q_1 + iQ_2$, $Q_{\mathrm{II}} = Q_1 - iQ_2$ linear combinations of the momenta around the principal axes and

$$U = Q_{\mathrm{I}}^2 + 4C\mu \sin \theta e^{-i\psi},$$

then Kowalewski's integral becomes :

$$UU^* + U^*U + 4h^2(Q_{\mathrm{I}}Q_{\mathrm{II}} + Q_{\mathrm{II}}Q_{\mathrm{I}}) = \text{Diag. Matrix},$$

which differs from the classical result by the symmetrisation and by the last term proportional to h^2. AUTHOR.

2218. Uncertainty Relations and Volume of Photons. D. Meksyn. *Phil. Mag.* 15. *pp.* 592–601, *March,* 1933.—The laws of quantisation of an electromagnetic field are applied to derive the exchange relations between the electric and magnetic field of a photon, associated with a plane wave, and their bearing with respect to Jordan's, Pauli's, and Heisenberg's exchange relations is discussed. The uncertainty between the electric and magnetic force of a single photon is found to be proportional to its energy. The exchange relations for the electromagnetic field due to the superposition of n similar photons, each of energy $h\nu$, is shown to be proportional to $1/n$, and, if n is sufficiently great, the separation of the electromagnetic field into an electric and magnetic field can be carried out with a sufficient degree of approximation. The volume of a photon is found to be $3\lambda^3/8\pi$, where λ is its wave-length. H. H. Ho.

2219. Group Theory of Valency States. S. C. Kar. *Zeits. f. Physik,* 81. 1–2. *pp.* 139–142, *March* 3, 1933.—A group theory method of calculating the valency states of an atom is indicated, using Slater's method of introducing the spin function [see Abstract 1452 (1930)]. G. G. S.

2220. Quantum Mechanics of Seven and Eight Electrons with Spin Degeneracy. H. Eyring and G. E. Kimball. *J. Chem. Phys.* 1. *pp.* 239–246, *April,* 1933.—The eigenfunctions corresponding to the fourteen singlet states of a system of seven or eight electrons are given and the corresponding matrix elements tabulated in a form convenient for computation, neglecting multiple interchange integrals. Proof is given that the general method described in earlier work [see Abstracts 94 and 1293 (1933)] for writing bond eigenfunctions suffices to separate the multiplets. A method for calculating matrix components between bond eigenfunctions directly from the bond systems is also described. AUTHORS.

2221. Variable Scale Atomic Wave Functions. J. P. Vinti and P. M. Morse. *Phys. Rev.* 43. *pp.* 337–340, *March* 1, 1933.—In the study of complex atomic spectra by the methods of Slater and Condon, it is desirable to have a complete set of orthogonal wave functions more nearly correct than the hydrogenic ones. A set of variable-scale wave functions is described in this paper and applied to some simple cases. They are hydrogenic functions of a function of the radius, such that close to the nucleus they behave like the wave functions about a charge Ze and far from the nucleus they behave like the wave function about a charge e. The scale function is chosen so that the integrals arising in calculation can be handled analytically. These functions are not so accurate as the analytic representations of the Hartree functions, but they form a complete orthogonal set, and thus can be used for perturbation problems. AUTHORS.

2222. Atomic Wave-Functions Expressed in Terms of Momenta. W. Elsasser. *Zeits. f. Physik*, 81. 5–6. *pp.* 332–345, *March* 22, 1933.—In the solution of problems in quantum mechanics it is often useful to use the momenta, instead of the coordinates, as the fundamental variables. By means of an integral due to Fourier it is shown how any function of the coordinates can be transformed so that the corresponding momenta appear as the variables. The method is applied to give the wave-functions of the harmonic oscillator and rotator as well as those of the hydrogen atom. G. C. McV.

2223. Electron and Proton Spin Moments and their Possible Orientations Derived from the Quantum Dynamical Relativity-Invariant Differential Equation of the Many-Body Problem. H. Seyfarth. *Ann. d. Physik*, 16. 6. *pp.* 636–646, *March*, 1933.—Dirac, by iteration of his linear wave equation of the electron obtained the " energy equation " in which appeared a term which could be identified with the energy of the electron spin in the electromagnetic field. The author adopts a similar procedure with his linear wave equation for the many-body problem [see Abstract 4124 (1932)] to derive the magnetic moments associated with the spins of the component electrons and protons. For an electron, the magnetic moment of spin equals one Bohr magneton as in the single electron problem, and for a proton the magnetic moment of spin is one Bohr magneton times the ratio of the electron to the proton mass. It is also shown that the spin moments of all particles in the system must be orientated parallel or antiparallel, but, subject to this condition, the spin moments can be distributed between parallel and antiparallel in any mathematically possible arrangement. W. S. S.

2224. Superquantisation and Mechanics of Abstract Space. J. L. Destouches. *Comptes Rendus*, 196. *pp.* 529–531, *Feb.* 20, 1933.—Reasons are given for the employment of the wave function (ψ) of Hilbert in superquantisation processes. H. F. G.

2225. Classical Statistics and Quantum Mechanics. R. Fürth. *Zeits. f. Physik*, 81. 3–4. *pp.* 143–162, *March* 11, 1933.—Some relations between classical statistics—the classical diffusion theory and the theory of the Brownian movement—on the one hand and quantum mechanics on the other are discussed. In particular it is shown that the Heisenberg uncertainty relations can be made to follow from a classical statistical consideration of a cloud of moving particles. New light is thus thrown on the question of the limit of accuracy obtainable by measurement. G. G. S.

See also Abstracts 2109, 2114, 2226, 2227, 2416, 2471, 2496, 2621, 2622.

RELATIVITY AND ETHER.

2226. Quantum Theory in General Relativity. V. Bargmann. *Preuss. Akad. Wiss. Berlin, Ber.* 25. *pp.* 346–354, 1932.—The generalised form of Dirac's wave equation, valid in any space with Riemannian metric, put forward by Schrödinger [see Abstract 704 (1932)] is derived by a new method, which depends on the introduction of a certain operator. G. C. McV.

2227. Semi-Vectors and Spinors. A. Einstein and W. Mayer. *Preuss. Akad. Wiss. Berlin, Ber.* 32. *pp.* 522–550, 1932.—It is shown that every real Lorentz transformation, A, can be decomposed uniquely into two special Lorentz transformations, B and C, the coefficients of the transformation B being the conjugate complexes of those of C. The groups of the transformations B and C are therefore isomorphic to the group of Lorentz transformations. A semi-vector is a quantity with four complex components which, when the coordinates undergo a Lorentz transformation, itself undergoes a transformation of group B or of group C. The properties of these two types of semi-vectors are worked out and it is shown that the simplest differential equations they can satisfy are linear ones. It is further demonstrated that there are certain semi-vectors, the spinors, which possess certain properties of symmetry and have only two, instead of four, independent complex components. The theory is worked out from the mathematical point of view, but its application to quantum mechanics is indicated at various stages. G. C. McV.

2228. Larmor-Lorentz Transformation. O. J. Lodge and A. Lodge. *Phil. Mag.* 15. *pp.* 706–726, *March*, 1933.—A discussion by graphical methods of the Lorentz transformation of coordinates with a view to establishing that there is a unique time in the physical world. G. C. McV.

2229. Determinism in the Natural Sciences. J. Metallman. *Acad. Polonaise Sci. et Lettres, No.* 1–3. *pp.* 28–38, *Jan.–March*, 1932.—A discussion of the problem of causality which leads to the conclusion that determinism still exists in the domain of physical science.

G. C. McV.

2230. Metrics Employed in Einstein's Theory. J. Delsarte. *Comptes Rendus*, 196. *pp.* 534–536, *Feb.* 20, 1933.—An enumeration of the various possibilities of four-dimensional metrics whose coefficients depend at most on three of the coordinates. G. C. McV.

2231. Fundamental Affine Geometry of Unified Field Theories. D. D. Kosambi. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 342–345, 1932.—It is shown how the tensors employed in all recent unified field theories of gravitation and electromagnetism can be derived from two assumptions regarding the geometry of the field. Firstly, the assumption that there is a covariant derivative together with the parallelism it defines; and secondly, that a certain associated parallelism, connected with the covariant derivative, is derivable from a Riemannian metric. G. C. McV.

2232. Unitary Field Theory. J. A. Schouten. *Zeits. f. Physik*, 81. 1–2. *pp.* 129–138, *March* 3, 1933.—Shows that if the "projective" field theory is adopted, and the simplest density dependent upon field and wave is introduced as a world function, then with the notation $- + + + -$ the variation gives on the one hand the impulse-energy equation, and on the other hand one of Maxwell's equations, with a current term. With the notation $+ + + + -$ additional terms appear in both equations. Yet the latter notation is probably preferable. [See also Abstract 104 (1933).]

E. E. F. d'A.

2233. Relativistic Cosmology. H. P. Robertson. *Rev. Modern Physics*, 5. *pp.* 62–90, *Jan.*, 1933.—This report deals with the attempts which have been made during the last fifteen years to solve the general problem of the structure of the universe as a whole. A very brief summary of the general theory of relativity is given as an introduction. The static Einstein universe and the de Sitter universe are then considered as examples of stationary universes. Various types of non-stationary universes are enumerated, among them being universes in which energy is conserved and others in which matter is conserved. The effect of annihilation on the line-element is discussed. A summary of the present position of the problem is given. Some mathematical notes and a list of formulae conclude the paper; they deal with groups of motions, periodic universes, representation of space-time in five-dimensional flat space, the Minkowski diagram, Tolman's and Whittaker's definition of distance, Tolman's relativistic thermodynamics. A long Bibliography in chronological order is appended. H. L. B.

2234. Contributions to the Cosmological Problem and the Problem of the Propagation of Light in Gravitational Fields. M. Kohler. *Ann. d. Physik,* 16. 2. *pp.* 129–161, *Feb.,* 1933.—The field equations involving the cosmological term yield only *one* statical solution of the cosmological problem, which corresponds to a world filled with matter; this is Einstein's cylindrical solution. It appeared as if the general theory of relativity would give a unique answer to the question of the constitution of space as a whole. The Hubble effect made it necessary to postulate a non-stationary world. It is then found that if we assume a homogeneous distribution of mass and a spherical world it is possible to make unambiguous assertions about the nature of the variation of the space-metric with time only by suppressing the cosmological terms. The present paper shows that the field-equations are equally compatible with hyperbolic and Euclidean spaces as with spherical spaces. Solutions of the field-equations are also given which lead to homogeneous distribution of mass, but not to a geometry of constant (spatial) curvature; other solutions are obtained which give neither a spatially constant density of mass nor a geometry of constant curvature in three-dimensional space. Various special problems in non-stationary spaces of constant curvature are also discussed in detail. H. L. B.

2235. Expanding Universe. M. Bronstein. *Phys. Zeits. d. Sowjetunion,* 3. 1. *pp.* 73–82, 1933. *In English.*—It is sought to adapt the theory of the expanding universe based on general relativity, so as to exhibit the asymmetry between past and future. It is assumed that the equations of general relativity do not apply to the central portions of stars, which act as sources of energy, but only to the intervening portions of space. The equation for the rate of change of the radius of space is then worked out. It follows also that the " cosmical constant " must vary with the time. G. C. McV.

2236. Radial Motion of a Spherical Aggregate of Matter. J. Delsarte. *Comptes Rendus,* 196. *pp.* 678–680, *March* 6, 1933.—By means of the equations of general relativity, it is shown that a spherical aggregate of matter can only carry out a uniform outward radial motion provided the initial conditions satisfy certain inequalities. G. C. McV.

See also Abstracts 2256, 2497.

SOLUTION.

2237. Solubility of Sodium Chloride in Liquid Ammonia. G. Patscheke. *Zeits. f. phys. Chem.* 163. *Abt. A.* 5–6. *pp.* 340–350, *March,* 1933.—The measurements were made over the temperature range − 77° to 43°C. The solid in equilibrium with the solution is: at − 76·6°, solid ammonia for solutions containing from 0 to 0·28 % of the chloride; from − 76·6° to − 9·5°, the compound $NaCl.5NH_3$ for solutions containing

0·28 − 15·37 % of the salt; above − 9·5°, the pure salt, which diminishes in solubility from 15·37 % at − 9·5° to 1·76 per cent at + 43°. The stable maximum of solubility is at the transition point − 9·5 ± 0·2°. The solubility could be raised to 16·6 % in the unstable region beyond the transition point. The ammoniate, $NaCl.5NH_3$, crystallises in long needles or dense granules, and its heat of solution is calculated to be − 7·75 k.-cal. per mol. at − 10°C. T. H. P.

2238. Solubility of Oxygen in Gold and Gold-Silver Alloys. F. J. Toole and F. M. G. Johnson. *J. Phys. Chem.* 37. *pp.* 331–346, *March*, 1933.—The solubility of oxygen in gold and in alloys of gold with 95 %, 90 %, and 80 % silver was determined over a wide range of temperatures and at varying pressures. Gold was found to dissolve oxygen to the extent of 0·010 volume per volume of metal at the highest temperature, 900°C. and pressure, 700 mm. investigated. Below the critical temperature the apparent solubility is shown to be related to the pressure, so that $Q = aP^k$, in which k diminishes with decreasing temperature. The solubility phenomena below the so-called "critical" temperature is explained by the assumption of surface effects. Nitrogen is found to be insoluble in gold and in the gold-silver alloys of the above compositions. F. J. B.

2239. Solubility of Nitrogen in Water at 50°, 75° and 100° C. from 25 to 1000 Atmospheres. R. Wiebe, V. L. Gaddy and C. Heins, Jr. *Am. Chem. Soc., J.* 55. *pp.* 947–953, *March*, 1933.—A simple apparatus and methods for obtaining solubilities of gases in water are described. The absorption coefficient showed a distinct minimum at about 70°, which became more pronounced with increased pressure. J. E.

2240. Solubility of Nitrogen in Liquid Ammonia at 25° C. from 25 to 1000 Atmospheres. R. Wiebe and T. H. Tremearne. *Am. Chem. Soc., J.* 55. *pp.* 975–978, *March*, 1933.—A special high pressure apparatus for measuring solubilities of gases in liquids having high vapour pressures is described. Data with an accuracy in excess of 1 % were obtained for the solubility of nitrogen in liquid ammonia. N. M. B.

See also Abstracts 2138, 2591.

SURFACE TENSION AND COHESION.

2241. Surface Tension Measurements with Non-Aqueous Colloidal Solutions. E. W. J. Mardles. *Faraday Soc., Trans.* 29. *pp.* 476–485, *March*, 1933.—Surface tension measurements with numerous organosols have been made at different temperatures and concentrations by means of the drop-weight and maximum bubble pressure methods. The general behaviour of the colloids was to lower the surface tension of liquids with high surface tension, *e.g.*, formamide, benzyl alcohol, aniline, etc., and to raise that of liquids of low surface tension, such as ether, alcohol, or acetone. In this respect the colloids resemble many crystalloids. The surface tension of colloids in mixed liquids showed dependence to a large extent on the values obtained with the separate solvents, but the influence of the specific character of the substances used and the variation in solvent action with the composition could be clearly traced in many instances. Increased solvent action with its concomitant fall in colloidality resulted in a fall of the surface tension lowering effect. Mixed colloids in single liquids showed a surface tension equal to or slightly lower than the calculated value. No correlation could be observed between frothing and surface tension. T. H. P.

2242. Capillary Depression of Mercury in Cylindrical Tubes and Errors of Glass Manometers. W. Cawood and H. S. Patterson. *Faraday Soc., Trans.* 29. *pp.* 514–523, *March,* 1933.—Measurements are made of the capillary depressions of mercury in cylindrical glass tubes of various sizes. In order to eliminate refraction errors in the glass, it was found necessary to use very thin walled glass tubes. With such tubes it is possible to obtain measurements agreeing to less than 0·01 mm. The results are interpolated and a detailed table giving the relationship between capillary depression and meniscus height is deduced for tubes varying in diameter from 10 mm. to 19 mm. and for meniscus heights from 0 mm. to 1·8 mm. The results are compared with the figures given in other tables, and the deviations are discussed. The refraction errors in cylindrical glass tubes are investigated in some detail, and the bearing of these errors on the design of glass manometers is considered. AUTHORS.

2243. Allotropy of Liquid Nitrobenzene. E. L. Lind and T. F. Young. *J. Chem. Phys.* 1. *pp.* 266–268, *April,* 1933.—New measurements have been made of the surface tension and density of nitrobenzene between 6° C. and 20° C. No evidence of allotropy was found. Neither intensive drying with phosphorus pentoxide nor the addition of moisture produced any anomalous density changes, although some samples, cooled from higher temperatures, were kept for twenty-four hours at 6° C. AUTHORS.

2244. Capillary Rise at the Boundary and its Dependence on the Angle of Contact. K. Schultze. *Kolloid Zeits.* 62. *pp.* 294–305, *March,* 1933.—Following experiments upon the dependence of the capillary rise of liquids between parallel plates and their width [see Abstract 1813 (1932)], the rise of water and paraffin oil is measured up the sides of glass plates and rods by means of a movable feeler-arrangement attached to a micrometer screw. Two methods of measurements are used (1) that of the curvature and (2) the maximum rise above the main liquid surface. For rods and plates perpendicular to the surface the rise decreases as the width of the obstacle decreases. For inclined plates, the liquid rises more on the under than on the upper surface. A discussion is given of the relation between these effects and the angle of contact. H. M. B.

See also Abstracts 2154, 2170, 2466.

VACUA, HIGH.

2245. Vacuum-Valve. L. Wolf and S. v. Reichel. *Zeits. f. Elektrochem.* 39. *pp.* 143–145, *March,* 1933.—A description of a widely-applicable type of vacuum-valve, adjustable and without lubrication. A. D.

VISCOSITY, FRICTION AND LUBRICATION.

2246. Flow of Liquid Suspensions. E. G. Richardson and E. Tyler. *Phys. Soc., Proc.* 45. *pp.* 142–150; *Disc.*, 150–151, *March* 1, 1933.—Measurements of the velocity from point to point in a liquid rotating in the space between two concentric cylinders, of which the outer rotates while the inner is still, are made by means of a hot-wire anemometer. It is shown that in a suspension the velocity-gradients are abnormal but can be explained in terms of a variable viscosity, which is a function of the velocity-gradient. AUTHORS.

See also Abstracts 2116, 2122, 2172, 2173, 2175, 2189, 2560.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

2247. New Aircraft Sextant. L. Becker. *Roy. Astron. Soc., M.N.* 93. *pp.* 185–190, *Jan.*, 1933.—With this instrument the visible horizon is reflected vertically downwards into a telescope from three points: facing the observer, and 60° to his right and left. These images appear as three intersecting straight lines, and the observation consists in bringing the image of the celestial object into a certain point defined by the configuration of the lines. Instrument and methods of using it are described. M. A. E.

2248. Use of Bubble Sextant at Sea. E. O. Hulbert. *J.O.S.A.* 23. *pp.* 143–148, *April*, 1933.—Altitudes of celestial objects were observed with the bubble sextant from a 950 ton ship and a 12 ton craft at sea. For moderate sea conditions individual altitudes were occasionally as much as 60′ of arc in error and averages of 5 consecutive observations were usually correct within 30′ of arc. On the 950 ton ship a portion of the error was due to the vibration of the ship caused by wind, engines, etc., and a larger portion was due to the horizontal acceleration arising from the roll and pitch of the ship. If the roll were simple harmonic the latter error could be partially eliminated by taking the sextant altitude at the midpoint of the roll. A small pendulum device was arranged to sound a buzzer signal at the midpoint of the roll and the sextant observations were made simultaneously with the buzzer signal. This improved the accuracy of the bubble sextant altitudes by roughly a factor of 2, so that individual observations were rarely more than 30′ of arc in error and averages of 5 consecutive altitudes were usually correct within 15′ of arc for a moderate sea. AUTHOR.

See also Abstracts 2274, 2375.

COMETS AND METEORS.

2249. Observations of Leonids at Helwan Observatory, 1932, November. P. A. Curry. *Roy. Astron. Soc., M.N.* 93. *pp.* 190–192, *Jan.* 1933.—A special chart was made and mounted on ground glass, according to a method of Hinks, with small punched holes showing the positions of stars to 4th magnitude, and lighted from below. This was found very useful for plotting meteor trails rapidly. Moonlight, haze, and cloud hindered observation, but on the clearest night, which was November 16, 133 meteors were counted between 1 and 5 a.m., 47 of which were brighter than Jupiter. The time of maximum frequency seems to have been about 4 a.m. on November 17, but at no time was there any striking display. M. A. E.

2250. Meteorites and the Age of the Universe. E. Öpik. *Popular Astron.* 41. [9 *pp.*], *Feb.*, 1933.—Paneth's conclusion from the fact that there is no distinction between the ages deduced from the helium content of meteorites regarded as of solar origin and of those deemed to have had hyperbolic velocities, that these velocities were due to erroneous observation, and that therefore all the meteorites examined must be of solar origin [see Abstract 396 (1931)] is disputed on the ground that the observations were certainly not all inaccurate [see Abstract 1908 (1932)]; while data relating to wide double stars, the distribution of stellar luminosities in globular clusters, and the recession of spiral nebulæ are all consistent with the age of the stellar universe being of the same order of magnitude as that of the solar system, or not much more than 3×10^9 years. C. A. S.

2251. Origin of Tektites. L. J. Spencer. *Comptes Rendus*, 196. *pp.* 710–712, *March* 6, 1933.—Tektites consist of impure vitreous silica. They result from the heat developed by the impact of a large meteorite on predominantly siliceous material, and are therefore very resistant to weathering. Comparison of analyses of five tektites, of two sandstones, and of an arkose-leptite support this view. C. A. S.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2252. Variable Parameters and Asymptotic Prevision in Some Problems of Celestial Mechanics. G. Krall. *Accad. Lincei, Atti*, 17. *pp.* 123–129, *Jan.* 22, 1933.—Deals with the application of adiabatic invariants to problems concerning the valuation of the effects due to slowly varying parameters in the motion of dynamical systems. The problem of two bodies is here dealt with from this point of view. A. J. McC.

LATITUDE AND LONGITUDE.

2253. Preliminary Work for the International Longitude Measurements, 1933. E. Lange. *Naturwiss.* 21. *pp.* 186–190, *March* 3, 1933.—A large series of widely distributed stations will take part in the tests during Oct.–Nov., 1933. It is hoped by comparison with the results of 1926 to get information relating to continental drift, submarine folding along the coast, and pulsations, contraction and expansion of the earth's crust. The various sources of error are reviewed. The astronomical errors include the personal errors of the observer and of bisection, the illumination of the field of view and errors in cataloguing stars, The errors in transmission and reception of the signals and methods of avoiding these are discussed. In the reduction of the observed longitude differences there are possible errors due to polar distance, depth of earth crustal layers, lateral refraction, pressure of the atmosphere, changes with the season in earth covering, seasonal differences in propagation of electromagnetic waves, lunisolar attraction and the motion of the earth through space. Various problems on which light may be thrown by these observations are discussed. R. S. R.

2254. Variation Effect in Latitude Correlatable with the Moon. H. T. Stetson. *Nature*, 131. *p.* 437, *March* 25, 1933.—Reductions have been made for four of the international latitude stations for the years 1909–11 and the resultant residual variations in latitude grouped both by hour angle and declination of the moon. A graph shows the results for north declination, south declination and for the time when the moon is between 12° N. and 12° S. The resemblance of the curves to diurnal curves of equilibrium tides gives confirmatory evidence of an earth tide hypothesis. The inversion of phase for the change in the moon's declination is particularly significant. The magnitude of the effect being 5–10 times greater than that on the basis of our present knowledge of earth tides, suggests a possible mobility in the earth's crust at right angles to gravity. Such a hypothesis appears consistent with the results of tilt experiments, such as that of Michelson and Gale, and the displacements of the zenith here recorded in astronomical observations. R. S. R.

NEBULÆ.

2255. Proper Motions of Twenty-one Planetary Nebulæ. A. van Maanen. *Mt. Wilson Observat. Contrib. No.* 463. *Astrophys. J.* 77. *pp.* 186–194, *April,* 1933.—From photographs taken at the 80-foot focus of the 60-inch reflector proper motions were derived for fifteen more planetary nebulæ, making a total of twenty-one nebulæ. The mean interval between the old and the new plates is 12·22 years; the probable error of the mean motions is 0″·0009 in α and 0″·0010 in δ. The results for the absolute motions of all twenty-one objects range from 0″·002 to 0″·017, the mean being 0″·007. The mean parallax derived from these results is about 0″·0007, yielding an absolute photographic magnitude of + 1·9 for the central stars and an absolute bolometric magnitude of − 0·8. AUTHOR.

2256. Distances and Motions of Extra-Galactic Nebulæ. H. Knox-Shaw. *Roy. Astron. Soc., M. N.* 93. *pp.* 304–317, *Feb.,* 1933.—The author accepts Hubble's classification and discusses his three methods of determining the distances; also the zero point of the Cepheid period-luminosity relation; and the assumption that the brightest stars detected in extra-galactic nebulæ are in fact stars, and not clusters of stars, with the effect—if this is so—on the scale of distances. He considers the photographic magnitudes of the Catalogue of 1249 extra-galactic nebulæ, and finds a mean absolute photographic magnitude for them of − 14·5; this involves an increase of 38 % in Hubble's scale of distances in so far as it depends on the nebular magnitudes. The radial velocities indicated by the G band, H δ, H β, H γ and 4383 Å show that the shifts to the red are true Doppler effects. He tests the rate of expansion (E) of the isolated nebulæ by (*a*) the stars found in them, (*b*) Harvard, and (*c*) Mount Wilson magnitudes; finds them accordant and gives a diagram of the velocity-distance relation for the Isolated (grouped) and Cluster nebulæ, indicating 584 and 419 km/sec. per megaparsec (this is the only instance of want of uniformity between the two classes), the individual values of Hubble's classes giving accordant results for E = 590; he determines approximately the average peculiar velocity of the nebulæ as 140 km/sec.; he finds no appreciable absorption of light in extra-galactic space, but does in the galactic plane, and suggests that the " nucleus " of our galaxy may be masked by the Sagittarius clouds. He examines van de Kamp's value of the absorption and finds that his hypothesis is inconsistent with the figures; if there be a uniform absorbing layer, its optical depth must be much less than $0^m\cdot 8$. A. S. D. M.

2257. Peculiar Spectra in Magellanic Clouds. Annie G. Cannon. *Harvard Coll. Obs., Bull. No.* 891. *pp.* 2–6, *March* 1, 1933.—Tables of 29 gaseous nebulæ, 18 stars of class O, and 2 stars of P Cygni type taken with the 24-inch Bruce and 10-inch Metcalf telescopes at Bloemfontein. Notes are given of the appearance of the nebulæ. H. D. 33540, hitherto assumed to be of the P Cygni type is now found to have nebular lines, and Hβ is twice as strong as the chief nebular line. 17 of the O stars are in the Large Magellanic Cloud; all the spectra are faint and show only the wide emission band at 4686. Of the three classes there are now 13 objects in the small Cloud as against 100 in the large Cloud. A. S. D. M.

PLANETS.

2258. Brightness and Variation of Asteroid Eros. J. Rosenhagen. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 5–7. *pp*. 457–464, 1932.—The author reduces the observations of Graff, 1930–1931; results: magnitude, mean opposition, 9·96; coefficient of phase correction, + 0·0223; full comparison with observations tabulated. Comparison with other series suggests that the constant magnitude when no variation is observed approximates to that of minimum rather than maximum. The author rejects the 2-body theory of the variation on the ground that the variation is excessive; and computes the position of the axis of rotation on the assumption of an ellipsoid of 3 unequal axes. The residuals are, however, such as suggest to the author that other elements must be introduced.

T. L. M.

STARS.

2259. Stellar Statistics. P. Rossier. *Arch. des Sciences*, 15. *pp*. 5–22, *Jan.–Feb.*, 1933.—In studying the relative numbers of stars belonging to different spectral classes, sufficient attention has not been paid to large systematic differences which are due to differences in sensitiveness to certain parts of the spectrum as observed by different eyes and different instruments. To obtain satisfactory results the observations should be reduced to the integral or bolometric standard, and although bolometers cannot as yet be made sufficiently sensitive to use for any but the brighter stars, this difficulty may be partly overcome by taking into consideration the colour indices. Several sets of statistics are compared and reduced, but for really accurate results fuller data are necessary.

M. A. E.

2260. Variations in Structure of the Hydrogen Lines in the Spectrum of H.D. 31293. P. W. Merrill and Cora G. Burwell. *Mt. Wilson Observat. Contrib. No.* 462. *Astrophys. J.* 77. *pp*. 103–109, *March*, 1933.—The hydrogen lines are very wide and diffuse with intense narrow cores having bright edges on the red side. K is somewhat similar. A few dark lines of Mg II and Fe II are present. Measured displacements of various lines are given. Those of the cores of the hydrogen lines vary through a range of 115 km./sec., but the wings remain nearly fixed. Orbital motion does not satisfactorily explain the facts. Atmospheric fluctuations having the same cause as the rapid motions in solar prominences are suggested as a possible alternative.

AUTHORS.

2261. Rotational Broadening of Stellar Absorption Lines in Classes B and O. Christine Westgate. *Astrophys. J.* 77. *pp*. 141–152, *March*, 1933.—The axial rotation of stars, as determined by the broadening of the Mg II line λ 4481, and of the He I line λ 4472, is studied statistically for 275 stars of class B. The widths of these lines in Ångstrom units were transformed into their corresponding equatorial velocities in km./sec. The observed frequency graph is compared with a theoretical curve which was constructed with regard to the probability of different inclinations of axes and with the assumption of an arbitrary distribution of equatorial velocities among stars. The best approximation to the observed curve is obtained by assuming that 27 % of the stars have $V_0 = 50$ km. per sec.; 53 %, $V_0 = 100$; 15 %, $V_0 = 150$; 4 %, $V_0 = 200$; and 1 %, $V_0 = 250$.

AUTHOR.

2262. New Method of Determination of Galactic Rotation. H. Mineur. *Bull. Astronomique*, 7. 9. *pp.* 383–413, 1932.—The author regards the problem of the structure of the Galaxy, whether a single spiral or a complex of spirals, as insoluble by methods based on the distribution of the stars. The study of galactic rotation may provide a solution. Of results obtained hitherto, the Oort hypothesis of an isolated spiral appears the most probable. The Dyson terms and the shape of radial velocity curves for distant stars provide a difficulty. Further Oort's hypothesis involves a negative absolute rotation of the galaxy ; reasons are given for supposing that the value actually adopted for this constant may be illusory. The author exposes an analogous assumption underlying Mohr's work, which appears to invalidate his conclusion. The proposed new method, eliminating the doubtful quantity, consists of computing for each point on the galactic plane the vector representing the mass velocity of the stars. At each point the curl of this vector is determined and the curves of constant curl define the centre of rotation. The author suggests how the method may be applied and gives variations for special cases. It is shown that the determination of the direction of the vertex at different points on the galactic plane may lead to a solution of the problem of galactic rotation. The results to be anticipated on the Oort-Lindblad hypothesis are predicted. T. L. M.

2263. Distribution of Absolute Luminosities in Globular Clusters. P. ten Bruggencate. *Zeits. f. Astrophysik*, 6. 1–2. *pp.* 138–143, *Jan.* 18, 1933.—The author derives theoretically, but does not apply, a method of deriving photometrically the function expressing the distribution of absolute luminosities in a symmetrical globular cluster. The problem of the distribution of stars of given luminosity within such a cluster is discussed. It is shown geometrically that no unique solution of the same problem for the local star system can be derived from stellar statistics. **Errata,** *ibid.*, 6. 3. *p.* 244, *April*, 1933. T. L. M.

2264. Rayleigh Scattering in Interstellar Space. O. Struve. *Astrophys. J.* 77. *pp.* 153–156, *March*, 1933.—A computation of the apparent brightness of the sky was made under the assumption that the observed reddening of distant stars is caused entirely by Rayleigh scattering. The result, for solid particles, is 3·0 stellar mag. per square degree for the scattering of general starlight in galactic space, and 7·3 mag. per square degree for sunlight scattered in and near the solar system. Scattering by atoms of interstellar gas is negligible. Since the total observed brightness of the night sky is 4·5 mag. per square degree, the density of the scattering particles is probably somewhat smaller than that obtained from the effect of reddening of distant stars. AUTHOR.

2265. Faint Southern Double Stars with Common Proper Motion. W. J. Luyten. *Roy. Astron. Soc., M.N.* 93. *pp.* 196–208, *Jan.*, 1933.—The author tabulates the results of blink microscope work on more than half the region S. of dec. — 60° ; the double stars are discovered by their common proper motion ; data given for 73 pairs likely to be physically connected and 29 more doubtful cases, include magnitudes, separation and quadrant, proper motion and position angle ; also theoretically estimated period and orbital motion. The periods are generally large and not directly observable ; the stars are generally dwarf. A very faint pair may be analogous to Krüger 60 and if so possess fainter absolute magnitudes than any yet known. In the theoretical part a correction to a previous paper [see Abstract 2778 (1930)] is given. In the present case, as the parallax is not known, the formulæ for the angular velocity and period are derived in a form which allows the application of statistical parallax and mass relations. The results are admittedly uncertain, but meet an empirical test reasonably well. T. L. M.

2266. Correlation Periodogram Analysis of R Scuti. D. Alter. *Astron. J. No.* 986. *pp.* 137–143, *March* 3, 1933.—Observations covering 18 years are analysed ; the usual period of about 144 days appears strongly. The periodogram shows a fairly regular beat pattern, minimum near 1400 days, maximum 2375, minimum about 4200. The result of analysis for sine term harmonics of 2375 days is given. Predictions were made for observations later published by McLaughlin, on the basis of repetition after 2375 days. The correlation is poor unless slight variations in the lag (2400 and 2350 over different ranges) are assumed. T. L. M.

2267. Spectrum Variable 73 Draconis. W. W. Morgan. *Astrophys. J.* 77. *pp.* 77–102, *March*, 1933.—The A2 dwarf 73 Draconis is a spectrum variable of the α Canum Venaticorum type. The EuII line λ 4205 varies in intensity in a period of 20·7 days. FeII–TiII 4549 and the TiII lines λ 4501 and λ 4571 vary in phase with λ 4205. It is possible that a number of other lines also vary in intensity. Wave-lengths and identifications for 477 lines between the limits λ 3902 and λ 4958 are given. A discussion of the relative number of atoms in the different states of excitation by the method of Russell and Adams is given for FeI and CrI. The number of atoms in the higher states of FeI is about the same for 73 Draconis and the " normal " A2 dwarf ϵ Serpentis, while there are twenty-five times as many atoms effective in absorbing low-level lines in the latter star as in the former. Two very peculiar features of the spectrum are the weakness of CaII K and the presence of numerous lines of CrI which are, except for the lines of very low excitation, actually stronger than in the sun. The lines of CrII are also strong, and the spectrum can be considered as representative of the " chromium stars." AUTHOR.

2268. Variation in Radial Velocity of α Orionis from 1923 to 1931. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 464. *Astrophys. J.* 77. *pp.* 110–119, *March*, 1933.—The observations show a mean long-period variation according well in time of phases with Jones's elements [see Abstract 2968 (1928)] ; the amplitude exceeds his by 50 %. No shorter periodicity is found. The velocity curve is so related to the light curve that the pulsation theory would require maximum light at minimum radius and the reverse. The change of radius would be about 30 % on either side of median radius, in general harmony with the (few) interferometer measures. Minor fluctuations in the two curves do not appear consistently related ; in the most pronounced secondary fluctuations there is some relationship of the inverse type specified. Surface temperatures, computed from apparent visual magnitudes and radii at maximum and minimum of light are reasonably near those of early M type. A five-fold variation of surface brightness is involved. But the spectrum appears always to show the TiO bands and to vary little if at all. T. L. M.

2269. Spectrum and Radial Velocity of U Monocerotis. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 465. *Astrophys. J.* 77. *pp.* 120–129, *March*, 1933.—Radial velocity spectrograms, 1922–1932,

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show a variation of 40 km./sec. in the centre of mass velocity in about 2300 days, two-thirds occupied by change from lowest to highest velocity. Removing this variation a velocity variation of 23 km./sec. with double maxima and minima in 92·26 days, the double photometric period, is found. The velocity of the system is + 34·6 km./sec. The enhanced lines are displaced to red of the arc lines by an amount equivalent to 5 km./sec.; blends no doubt affect this result. Hydrogen emission lines when present give displacement 39 km./sec. to violet. Phases for latest spectral class and associated features precede light minima by a few days, which probably (but with some doubt) precede velocity maxima slightly. Opposite phases come in similar order. T. L. M.

2270. Periods of the Be Spectrum Variables H.D. 20336 and 52 π Aquarii. D. B. McLaughlin. *Astrophys. J.* 77. *pp.* 221–225, *April*, 1933.—Attention is called to Lockyer's period of 1568 days for H.D. 20336, overlooked in preparing R. H. Curtiss' work for publication. The agreement between the Ann Arbor and the Sidmouth observations is close, and the agreement of phase of curves determined at places of such different longitude proves that the period is actually about 1600 days, and not close to 1 day. For π Aquarii, curves of emission ratio V/R and of velocities of hydrogen absorption and emission are given. These show large irregular variations, and V/R is closely correlated with velocity throughout the series of observations. The irregularity of the changes rules out any explanation in terms of binary motion. Attention is called to the fact that changes of V/R anticipate slightly the corresponding changes of velocity. AUTHOR.

See also Abstract 2257.

SUN.

2271. Heights in the Chromosphere from Fixed and Moving Plates. S. A. Mitchell. *Astrophys. J.* 77. *pp.* 157–185, *April*, 1933.—The heights in the chromosphere from eclipse spectra with good definition and dispersion are compared. With the fixed plate, spectra were obtained with prisms by Campbell in 1905 (with two spectrographs) and by Davidson and Stratton in 1926, and with a concave grating by Mitchell in 1905. With the moving plate, Campbell obtained spectra in 1905 and 1908. The comparisons of the published heights show differences in zero-point and in scale. The four spectra with fixed plates show little difference in zero-point. On the contrary, the moving-plate heights show the need of zero-point corrections. Both Menzel and Mitchell find that it is necessary to add corrections amounting to 300 to 500 km. to make the heights from the other spectra agree with those of the 1905 moving plate. The heights measured from any one spectrum may be reduced to the system of any other, or to a common standard, by applying corrections for zero-point and scale. AUTHOR.

2272. Measures of Coronal Streamers. F. de Roy. *Harvard Coll. Obs., Bull. No.* 891. *pp.* 1–2, *March* 1, 1933.—At the total solar eclipse of Aug. 31, 1932, six measures of coronal extent were made by means of a cross staff, 60 cm. in length with a cardboard bar allowing combinations of 1, 2, 3, 4 and 5 cm., and a peep hole of 8 mm. in diameter, over Old Orchard, Maine; the observer gliding in an autogiro from 4000 to 2200 ft. during totality. The atmospheric conditions were perfect.

The total coronal extent, E-W was 2°·9–3°·1, and N-S, 2°·0. For the N.W., S.W. and great N.E. streamers the extents were respectively 1°·0, 1°·1, and 2°·3 (at least 3,700,000 miles). A. S. D. M.

2273. Fraction of Solar Radiation Diffused by the Celestial Vault. L. Gorczynski. *Comptes Rendus,* 196. *pp.* 801–803, *March* 13, 1933.—Results of former measurements indicated that a fraction of 40 % of solar radiation was diffused. The author obtained measurements by pyrheliometer, solarimeter and spectrograph of the diffused radiation at Varsovie, Nice and Tacubaya (Mexico) and compared these values with older ones for Paris, Helsingfors and Sloutzk setting out seasonal and annual percentages of diffused to solar radiation. It is shown that the old figure applies only to stations with a certain cloud régime and is not applicable to others with greater solar radiation, such as the Côte d'Azur, and certain mountain stations with little low cloud. It is especially faulty in winter. R. S. R.

2274. New Method of Using the Spectrograph for Solar Rotation Work. J. Evershed. *Roy. Astron. Soc., M.N.* 93. *pp.* 165–168, *Jan.,* 1933.—The Ewhurst spectrograph is fed by a coelostat reflecting the sun southwards; by means of two other mirrors the light is again reflected horizontally northwards on to a focus on the spectrograph slit, so giving the east and west points of the solar image, permanently, on a horizontal diameter; the light from these east and west limbs have to be photographed simultaneously, and this is done by two right-angle prisms so placed as to reflect them upwards to a single plane mirror, which in its turn reflects them to the slit. It is necessary to cut off half of these spectra and avoid overlapping, and at the same time to insure that each beam will illuminate the collimator lens; a spectacle lens (plano-convex cylindrical) is therefore cut in half forming essentially two similar wedges of varying angle, and each half is placed over half the length of the slit and adjusted laterally, as explained by diagrams. Points slightly within the limb are chosen so as to avoid scattered skylight, and the means of obtaining the distance is shown. The methods of measuring the spectra obtained is described, and a single photograph of the D region is given. A. S. D. M.

2275. Hydrocarbon Bands in the Solar Spectrum. R. S. Richardson. *Mt. Wilson Observat. Contrib. No.* 466. *Astrophys. J.* 77. *pp.* 195–211, *April,* 1933.—Thirty-one lines in the λ4300 CH band, and twenty-nine in the λ3900 CH band, are identified with previously unidentified solar lines. The λ3900 band lines do not show the Zeeman effect in the sunspot spectrum. Twenty-four lines of the λ3143 CH band are also identified, making it probable that this band is also present in the solar spectrum. The ${}^2\Sigma^+$ state of the CH molecule is analysed and the moment of inertia of the molecule in this state is determined as $1\cdot941 \times 10^{-40}$ gm. cm.^{2} An analysis of the ${}^2\Pi$ state is also made, the moment of inertia being determined as $1\cdot949 \times 10^{-40}$ gm. cm.^{2} By means of a formula determined from the theory of band line intensities and the equation of dissociation equilibrium, the relative pressure in sun-spots and the reversing layer is calculated. The best spot spectrograms show that unblended lines in the P branch of the λ4300 CH band have practically equal intensity in spot and disc. This result, combined with the adopted temperatures spot = 4750°, disc = 5080° K, leads to the ratio of pressures for $P_C + P_H + P_{CH}$, spot to disc = 0·5. A. H.

2276. Microphotometry of the Solar Spectrum from 4040 Å to 4390 Å. R. v. d. R. Woolley. *Solar Phys. Obs., Cambridge, Ann.* 3. 2. *pp.* 79–118, 1933.—Part I of this paper gives the mathematical theory of the formation of absorption lines. The treatment is that first given by Eddington. Special attention is given to the Doppler effect. Part II records a set of observations of the microphotometry of the solar spectrum from 4040 Å to 4390 Å. The main tables of observations are designed to indicate the blending between those lines which are crowded together in this part of the spectrum. Central intensities are given for most lines. The equivalent breadth has been given as measured directly wherever possible. Where this is not possible an approximate equivalent breadth can be found from the observed central intensity. Part III gives a discussion of multiplet intensities. The multiplets are found to exhibit anomalous intensities in the solar spectrum. The calibration of Rowland's scale of intensities is discussed and followed by a note on the classification of solar lines according to contour. J. E. K.

2277. Eclipse Kinematography. S. A. Korff. *Rev. Sci. Instruments*, 4. *pp.* 86–87, *Feb.*, 1933.—The technique of obtaining a motion picture of a total eclipse of the sun is described. The extreme brightness of the solar image during the partial phases results in special problems. The slowness of the motion across the solar disc requires that exposures shall be made at longer than normal intervals. During totality a fast lens is required, and a higher film speed is desirable. A long focus and well-corrected lens should be used to give an image of sufficient size to show detail. The scientific value of such a record, especially as an aid in determining the exact times of contact and duration, is pointed out. E. E. F. d'A.

2278. Computation of Total Solar Eclipses. L. J. Comrie. *Roy. Astron. Soc., M. N.* 93. *pp.* 175–181, *Jan.*, 1933.—The author adapts the classical formulæ for computing the central line to the use of calculating machines, provides formulæ for rigorous computation of N. and S. limits of totality or annularity, and illustrates a specially designed computing form by the eclipse of 1940 Oct. 1 [see following Abstract]. A thorough and independent check is supplied. T. L. M.

2279. Total Solar Eclipse of 1940 October 1. L. J. Comrie. *Roy. Astron. Soc., M. N.* 93. *pp.* 181–184, *Jan.*, 1933.—The author supplies Besselian elements; the eclipse is visible from South Africa, for which central line, duration, altitude, N. and S. limits of totality are tabulated; and from Brazil, central line only given. A map of the track over South Africa is given; the best astronomical conditions there are on the west coast, 200 miles north of Cape Town. Pernambuco is considerably more favourable. T. L. M.

See also Abstracts 2383, 2636.

GEOPHYSICS.

GEODESY.

2280. Basic Equations of Physical Geodesy. F. Hopfner. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 5–7. *pp.* 449–455, 1932.—The main problem according to Bruns is the investigation of the multitude of surface levels of the earth. This, however, includes the special problem of the figure of the earth for a level surface selected at random, *i.e.*, the geoid. Equations are established for the Bruns theorem and the Bruns term and it is shown that the result is obtained by the solution of a partial differential equation of the first order. Former solutions obtained from a surface integral or the development of a series are shown to be only variants in the solution of the problem arising from the connection of the Bruns theorem with the solution of the partial differential equation. R. S. R.

2281. Critical Justification of the Contraction Hypothesis. F. Nölke. *Gerlands Beitr. z. Geophys.* 38. 2. *pp.* 172–194, 1933.—The author considers the various objections which are raised against the hypothesis of the earth's contraction [see Abstract 3187 (1932)]. These objections are arranged in two groups: (1) purely theoretical considerations relating to temperature changes, density of the earth and tension in the crust; and (2) the applicability of the hypothesis to explain the determined facts. The latter includes such factors as continental movements, foldings and fractures of the crust, changes of level and thrusting forces. It is considered that these objections are not conclusive and are based on suppositions which either are not confirmed by observations or are of another nature. R. S. R.

2282. Gravity at the Geoid. F. Ackerl. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 5–7. *pp.* 303–439, 1932.—The paper is based upon all known observations of the acceleration due to gravity (g) obtained from pendulum observations. The author in a theoretical treatment discusses Hopfner's procedure for the determination of the geoid from the closest network of gravity values at the earth's surface and the errors which have arisen by the use of other methods in determining the level of the geoid from values of g at mountain and valley stations. In Hopfner's method the values are reduced to sea level by a method free from potential theory, and it is shown from a theoretical treatment that the very simple procedure of Prey leads to a limiting value which one requires for the determination of the geoid. The methods of Brillouin and Rudzki which also lead to limiting values of the geoid are not considered here any further. The table of data contains a list of stations, with their latitude, longitude, height above sea level, local density of the earth, the observed value of g, free air and Bouguer reductions, topographical improvement and value of g corrected by Prey's procedure, year the observations started, name of observer and the source of information. Remarks are made on the sources of information. In the second part of the paper a chart of the gravity field over the earth is produced. From the individual values lines are obtained for equal values of g, smaller charts being united into a larger one with a Mercator projection of $1 : 2 \times 10^7$. Errors exist where the lines run from land to sea. Values of g are obtained to 0·01 cm./sec.^{2}. The theoretical basis of the development depends upon obtaining spherical functions up to the 16th order and a table with their values is given. R. S. R.

GEOPHYSICS, APPLIED.

2283. Electromagnetic-Wave Prospecting in U.S.S.R. A. Petrowsky. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. 2. *pp.* 149–204, 1933.—The author reviews the employment of electromagnetic waves for prospecting in U.S.S.R. in the period 1923 to 1930. Apparatus, first evolved in 1925, was employed during that year on a salt deposit in Iletzk. Improved apparatus evolved in 1927 was also tested in the same district. Further improvements in 1928 were tested on a pyrite ore-deposit at Tschiraghi-Dsor, in Trans-Caucasia, and in 1929 on a serpentine ore-deposit in the Urals. Final models were introduced in 1930. Full descriptions of the various transmitting and receiving apparatus evolved are given. The wave-length used varied between 50 m. and 500 m. In the latest model the maximum wave-length was 300 m. The receivers were provided with special galvanometer compensators for accurately estimating the strength of reception at various points. The theory of the propagation of electromagnetic waves in semi-conducting media is briefly reviewed, reference being made to the author's article in the *Mémoires de l'Académie des Sciences* (*St. Petersburg*), VIII, Series B. XXIV. N.6. p. 34, 1909. The theory employs Hertz's auxiliary function Π, and it is shown that not only are the speed of propagation V and the coefficient of absorption A dependent upon the specific resistivity of the medium, but that the amplitude of the electric force also depends upon it, so that the diminution of the wave with increasing distance r does not depend upon the factor e^{-Ar} alone. The formulæ are employed to deduce what distance of penetration in air r_0 the transmitter must have in order that the waves may penetrate a distance r in rock, and it follows that a smaller power suffices when the receiver can detect the magnetic force ; hence the use of a frame aerial in the receiver. It is also shown that, provided the wave-length does not exceed the distance between transmitter and receiver, it is theoretically advantageous to use as long waves as possible. The tests at Iletzk demonstrated that there was no difficulty in picking up electromagnetic waves after transmission through 100–150 m. of salt. Those at Tschiraghi-Dsor, on a pyrite ore-body, showed that the ore-body gave an electromagnetic " shadow," and indicated the practical utility of the method for outlining the boundary of a deposit. There also appeared evidence of interference phenomena resulting in a minimum of intensity of reception at some wave-length, which was about four times the average height of the neighbouring trees. From the data at Tschiraghi-Dsor the absorption-coefficient of quartz was calculated as about 0·1 per metre of rock for the wave-lengths used. The determination of the wave-length of the transmitted signal in the actual rock is considered on theoretical grounds, using the interference of the transmitted wave with the air-borne wave arriving at the receiver *via* the shaft and surface. It is shown that a reduction of wave-length of 20 % is easily possible. Tests on the serpentine deposit in the Urals showed that a 60 m. air wave was reduced to 12 m. in transmission through the rock. The maxima and minima of reception due to the interference of the two waves were very clearly shown. The article concludes with a discussion of the necessity for dealing with averages of electromagnetic constants in practical geophysics. In practice, for various reasons, the rocks *in situ* are not homogeneous, and laboratory determinations of rock characteristics can only be regarded as approximately valid. E. L. J.

See also Abstracts 2285, 2302.

HYDROSPHERE, PHYSICS OF THE.

2284. Principal Semi-Diurnal Constituent of Tidal Motion in the Gulf of Mexico. S. F. Grace. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 156–162, *March,* 1933.—In the present paper the M_2 tidal motion is considered, using the same method as in a former paper [see Abstract 3613 (1932)]. The basin is subdivided into a number of rectangular basins and four subsidiary motions are considered. The semi-diurnal tide of the Gulf of Mexico is finally regarded as a linear combination of these four tides, and a comparison between theory and observation is used to determine the external currents. The method is not quite so successful as for the K_1 tide, and reasons are given to account for some of the discrepancies which occur, resonance and shallowing accounting for some of the differences. Fair agreement is obtained in amplitude at all stations except Cedar Keys and St. Mark's, and the mean error in phase except on the north coast is about 4°. The external currents given by theory, compared with available observations are of the right order of magnitude, but agreement of phase is lacking in the Yucatan Channel. A co-tidal and co-range chart has been constructed. The co-tidal lines correspond to a positive amphidromic point to the northwest of the centre of the basin together with a wave entering through the Florida Channel. The motion in the basin is discussed. The co-tidal chart differs from that given by Harris and more nearly resembles that given by Sterneck. R. S. R.

See also Abstract 2310.

LAND, PHYSICS OF THE.

2285. Apparatus for Measuring the Magnetic Properties of Rocks. G. Grenet. *Comptes Rendus,* 196. *pp.* 874–875, *March* 20, 1933. —An apparatus is described by which the magnitude and direction of the remanent magnetisation of a rock specimen, and its susceptibility in three perpendicular directions may be determined without requiring to take into account the form and non-homogeneity of the specimen. G. E. A.

See also Abstracts 2283, 2289, 2302, 2306, 2307, 2308, 2309, 2314.

METEOROLOGY.

2286. Review of the Physics of the Upper Atmosphere. J. Bartels. *E.N.T.* 10. *pp.* 1–40; *Disc.,* 59–60, *Feb.,* 1933. *Sonderheft.*— A comprehensive review is given of the present state of knowledge of the physics of the upper atmosphere, with short accounts of the methods employed to obtain such knowledge. A full Bibliography is also given. A. W.

2287. General Theory of Turbulent Friction and of the Interchange. H. Ertel. *Preuss. Akad. Wiss. Berlin, Ber.* 26. *pp.* 436–445, 1932.—The author refers first to the results obtained from experimental investigations by Robitzsch, Schmidt, Becker, Scrase and Giblett and states the equations of motion obtained by different people in which the virtual friction term is used to give the variation with height, turbulent energy, and the transverse frictional coefficient. Although his theory is based on previous results he shows in a series of theorems how interesting results regarding the internal structure of turbulent flow may be obtained and the theory is applied to the stationary geostrophic antitriptic wind field. He shows that former theories in which the turbulent state is characterised by a scalar function, " the interchange coefficient," is reached only in special cases, because the description of the turbulent state in general requires a knowledge of a symmetrical tensor interchange of which the Schmidt interchange shows only a component. This misconception arose from the development of the theory of virtual friction and interchange from steady air and water flow in which all quantities depended only on the vertical coordinate of height, but the frictional component of the interchange tensor enters. A full Bibliography is given. R. S. R.

2288. Dust Motion in Electric Fields. S. Franck. *Phys. Zeits.* 34. *pp.* 214–218, *March* 1, 1933.—Using lycopodium and sugar dust the author has examined the forms taken by the dust when subjected to homogeneous and inhomogeneous electric fields, and a series of photographs is reproduced. J. E. R. C.

2289. Diluvial Ice Age in Equatorial Regions. R. Spitaler. *Gerlands Beitr. z. Geophys.* 38. 2. *pp.* 220–227, 1933.—It was shown in an earlier paper [see Abstract 3160 (1932)] for perihelion $\Pi = 270°$ and eccentricity $e = 0\cdot07$, that a cold northern summer corresponded to a cool southern winter and consequently there exists the possibility of an ice age spreading across the equator. Evidence of such conditions was obtained by Meyer and Hann, for tropical equatorial Africa and in the Andes of Ecuador, Peru and Bolivia, where in glacial times the ice was at a level 600–700 m. lower than now. The author calculates and tabulates values of temperature for each 10° of latitude from 40°N. to 40°S. for four eccentricities and perihelion 90° and 270° to obtain differences of summer and winter temperatures and the mean temperature of the four seasons. Calculated and observed values agree well. The means of the calculated and observed values are used to obtain for perihelion 90° and 270° and for $e = 0\cdot07$, the temperature changes across the equator. These results explain the cooler summers and warmer winters with a lower limit for the ice level. The glaciation in the tropics can be explained in this way. Further, at greater eccentricity the equatorial regions are more influenced by the northern than the southern hemisphere. R. S. R.

2290. Brightness of Twilight at Mallorca with Solar Altitudes between − 9° and − 13°. K. Graff. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 509–513, 1932.—Further data have been obtained for the brightness of the sky after sunset and before sunrise by a photometer method using the same procedure as before [see Abstract 765 (1932)]. Positions in the sky were fixed by stars and the solar altitude calculated. Curves show the change of the twilight isophotes for solar altitudes − 9° to − 13° in the morning and evening. While the evening observations are free from objection, those in the morning are less reliable, although the curves show the same eccentricity to the zenith. Curves were obtained also connecting solar altitude and zenithal distance for various isophotes. The results for minimum brightness agree with those obtained by Dorno. R. S. R.

2291. Improvements in Psychrometry. D. B. Brooks and H. H. Allen. *Washington Acad. Sci., J.* 23. *pp.* 121–134, *March* 15, 1933.—The paper describes a number of separate contributions to hygrometry, among them being (1) a simple means of supplying water to the wet bulb at its own temperature, for use at high dry-bulb temperatures. (2) An investigation of the effect of considerable variations in pressure, corresponding to the wide range of values now met with in aeroplane work. (3) A study of the wet- and dry-bulb hygrometer below 0° C. when the wet bulb is covered with ice instead of water. (4) A new chart of high precision embodying the nomogram principle. J. H. A.

See also Abstracts 2297, 2300, 2304, 2305, 2345, 2346.

SEISMOLOGY.

2292. Apparent Velocity of Propagation of Superficial Earth Tremors. C. Alessandri. *Accad. Lincei, Atti*, 17. *pp.* 141–146, *Jan.* 22, 1933.—The problem of the depth of seismic hypocentres is in an unsatisfactory condition; the data are lacking in precision. But there is one feature which is precise, the apparent resultant velocity of propagation from place to place along the earth's surface. The author investigates how to compute the hypocentric depth from these data. A. D.

2293. Rediscussion of Some Near Earthquakes. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 131–156, *March*, 1933.—Seven European earthquakes and the Oppau explosion are rediscussed, values being found for the velocity, time of starting, and standard error of each pulse. Four intermediate layers are indicated between the granitic and the lower layers. It appears that the notations P^* and S^* have been applied to waves in the upper two of these layers, P_q to the next, and P_x and S_x to the lowest; while P_n is probably the wave in the true lower layer, and the corresponding S_n has not been traced in near earthquakes. The difference previously noticed between the apparent times of starting of P_g and S_g has been confirmed, and implies that the movement sent out from the focus is wholly distortional in character, compressional movement being produced only by reflection at the outer surface. The same result is given by the times of P_x and S_x. The focus for the Hereford earthquake may have been near the base of the granitic layer, but in other cases the foci were in the granitic and not far below the base of the sediments. In mountainous regions the thickness of the sedimentary layer is about 6 km. and of the granitic layer 10–12 km. In low lying regions the two layers have a total thickness of about 6 km. less. For other layers the thickness is doubtful. The upper two together are probably 15 km. thick, but the others can hardly be found from observations. The upward curvature of the P_g time-curve at small distances is possibly due to this wave having been reflected at the base of the granitic layer; at greater distances the existence of short periods in the wave trains following the main pulses indicates reflection near grazing incidence. R. S. R.

2294. P- and S-Curves Derived from the Tango Earthquake. E. A. Hodgson. *Dominion Observat., Ottawa, Pamphlet No. M*6 [13 *pp.*], 1933.—Revised tables are given for the P- and S-curves, in the latter case only for epicentral distances > 10°, and of the differences S-P, with an argument of 0·1°, corrected for the error of 11 sec. in the time at the origin. [See also Abstracts 538 and 982 (1933).] C. A. S.

2295. Third-Order Aberrations of Seismograph Springs. L. F. Richardson. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 125–131, *March*, 1933.—In the author's design of seismograph springs it was shown that in a finished instrument the second-order aberration was removed, but there were difficulties about the third-order for the period of oscillation increased with the amplitude [see Abstract 856 (1927)]. A mistake occurred in the theory of the third-order and is corrected in the present paper, five conditions being obtained which must be satisfied simultaneously. One such solution which is convenient for the instrument maker is shown diagrammatically, the springs satisfying Hooke's Law. An independent check of this design is given in which the computation is extended to $\psi = \pm 30°$, although the working range of the seismograph is more like $\pm 0°\cdot 1$. Theory does not quite agree with observation, and for this elastic hysteresis may be responsible. It is suggested that springs will need to be made of some special substance, such as fused silica, if full benefit is to be derived from the thorough elimination of the geometrical aberrations. R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2296. Phases of the Explosion of Fulminant Matter on Cooling. E. Mathias. *Comptes Rendus*, 196. *pp.* 654–657, *March* 6, 1933.—In this note the author deals with the behaviour of fulminant matter as recorded at different times and in different places. Such matter if sufficiently cooled becomes explosive and in colour is usually dull red. The cases considered are those of ball lightning of different form and of beaded lightning. In the life history of each type three stages are observed following the dull red stage: (*a*) a dazzling white appearance, and (*b*) an expansion, followed in a short time by (*c*) an explosion. The explosion is due to progressive decomposition from which heat is liberated giving rise to the stages indicated. A. E. M. G.

2297. Influence of Atmospheric Suspensoids upon the Earth's Electric Field. H. L. Wright. *Phys. Soc., Proc.* 45. *pp.* 152–170; *Disc.*, 170–171, *March* 1, 1933.—Changes in the electrical resistivity of the air and in the potential-gradient may be associated with changes in the concentration of gross particles and of condensation nuclei. Observations of these four quantities made at Kew Observatory over a period of three years are analysed with a view to formulating functional relations between them. The observations indicate that resistivity depends upon the number of gross particles and of condensation nuclei, while potential-gradient varies with resistivity and the number of nuclei. The theoretical implications of this statement are considered. AUTHOR.

2298. Theory of Lightning. F. Ollendorff. *Arch. f. Elektrot.* 27. *pp.* 169–184, *March* 15, 1933.—The work here described has reference not to the development stage of lightning flashes, but to the quasi-stationary stage when the flash is fully developed. Certain simplifying assumptions are made, and then the arc conductivity is calculated for an atmosphere of monatomic nitrogen whose electric temperature ionisation is determined from Saha's formula. The excess pressure within the luminous column is calculated from the hypothesis that the partial pressure of the ions in the luminous column plasma is taken up by the electrodynamic current pressure of the parallel directed current threads. Assuming a stationary state, with balance of both matter and charge, an estimation is made of the energy output due to convection and radiation, and the geometric and electric data of the column are associated with its electric power. From this certain regularities in the time behaviour of lightning flashes are deduced. In particular, a simplification is obtained of the assumptions of Walther, whose partial discharges may be considered as relaxation oscillations. A comparison between the calculated results and experiment shows that the theoretical results obtained are useful within limits. A. W.

2299. Progressive Lightning; New Stereoscope. C. V. Boys. *Nature*, 131. *pp*. 492–494, *April* 8, 1933.—To study the behaviour of lightning flashes the author invented in 1900 a camera having two revolving lenses [*Nature*, 118. *pp*. 749–750, *Nov*. 20, 1926], but did not succeed until articles 1928 in obtaining successful photographs. Since then he has shown in contributed to *Nature* how to interpret the photographic records, referring in particular to a stereoscopic method. In the present article he again refers to his previous work and to recent results from similar work obtained by E. C. Halliday [see Abstract 1821 (1933)], indicating that the stereoscopic method could be used with advantage on Halliday's photographs. In the original stereoscopic method the print was cut in two in order to get the images placed parallel. The present article describes a new stereoscope built from two halves of a convex lens and two right-angled prisms truncated and mounted in two tubes. This arrangement enables the print to be examined without cutting and also permits of viewing the images first with one pair of edges adjacent and immediately afterwards, by turning the prisms, with the other pair adjacent. A. E. M. G.

2300. Numbers of Charged and Uncharged Condensation Nuclei in Town and Mountain Air. P. F. Schachl. *Gerlands Beitr. z. Geophys*. 38. 2. *pp*. 202–219, 1933.—Particulars are given of a large series of measurements of the total number (Z) of Aitken nuclei, and charged nuclei of small mobility (large ions), N, and medium mobility (intermediate ions), N_i, per c.c. of air. Measurements were made in Innsbruck and its surroundings from Oct., 1931, to Sept., 1932, using the method of Nolan, Boylan and de Sachy. It was found that the nucleus content was diminished by rain, the supply of pure air from the open country, or by föhn winds, and by mixing of the lower atmospheric strata by strong wind or vertical motion produced by insolation. Measurements in the city of Innsbruck show that the ratio, N_0/N, (N_0 = no. of uncharged nuclei) does not vary regularly with Z and the humidity as indicated by Israel's results. For a humidity > 90 % or during rainy weather in Innsbruck the ratio N_0/N is $2 \cdot 2$, the same value as for country air. The meteorological effects are less well marked for large ions than for intermediate ions. On days without rain N_i diminishes rapidly compared with N, when the barometric pressure is changing rapidly. Minimum values of N_i occur with high absolute humidity. The constant relation between N and N_i found by Hogg in Australia was not confirmed. In mountain air of highest purity Z falls off very rapidly with increasing altitude and above 1800 m. it is almost constant at 500/c.c. A very marked diurnal variation of Z was found on a mountain site, Maria Waldrast. At such sites, far from human habitations, N_0/N is approximately $2 \cdot 2$, provided $Z > 900$/c.c. For very low values of Z (< 900), however, practically all nuclei are charged. The number of intermediate ions is then negligible. [See Abstracts 1713 (1925) and 4294 (1931).] R. S. R.

2301. Multiply Charged Large Ions. J. J. Nolan and J. G. O'Keeffe. *Roy. Irish Acad., Proc*. 41. *pp*. 26–40, *Jan*., 1933.—Continuing previous experiments [see Abstract 2524 (1932)], ion-counting observations made with an Aitken's nuclear counter show that the atmospheric nuclei or nuclei produced by flames can be charged up so as to carry several

thousand electronic charges. The mobilities of these bodies do not seem to be affected by their charges. Spray-ions have charges of the order of a hundred electrons. In contradiction to the assertions of Blackwood and of Busse, the existence of definite mobility groups is again demonstrated.
F. C. C.

2302. Terrestrial Magnetic Elements and Structure of the Earth's Crust in Japan. T. Terada. *Imp. Acad. Tokyo, Proc.* 9. *pp.* 3–5, *Jan.*, 1933.—Magnetic anomalies for Japan and Corea are plotted on maps, and compared with gravity anomalies. It is found that these anomaly charts are useful to some extent as data for deducing crustal structure. W. A. R.

2303. Apparatus for Measurement of the Earth's Magnetic Field. L. F. Bates. *Phys. Soc., Proc.* 45. *pp.* 180–192 ; *Disc.*, 193, *March* 1, 1933.—A new method for the determination of the horizontal and vertical components of the earth's magnetic field is described. A small cylinder of mu-metal is wound with fine wire whose ends are connected to wires forming a torsional suspension. This cylinder is placed with its centre at the mid-point of a Helmholtz coil system whose axis is adjusted to coincide with the direction of the component of the earth's field which is to be measured, the suspension being perpendicular to the component. The current through the coil system can be adjusted so that there is no deflection of the suspended cylinder when the current in the solenoid wound upon it is reversed, in which case the calculated field produced by the coils is equal to the required component. The sources of error peculiar to the method are examined and their elimination is discussed. It is shown that measurements of high accuracy are possible. AUTHOR.

2304. Most Important Results of Auroral Investigation. C. Störmer. *E.N.T.* 10. *pp.* 60–68, *Feb.*, 1933.—The author separates auroræ into two main types, those with or without ray structure. The former are brighter, more mobile and more beautiful and include draperies and the corona. The latter include the homogeneous arc and bands and pulsating surfaces. Reference is made to Frety's chart of auroral frequency and to the 11-year auroral period. The apparatus used and the main results obtained in Norway on auroral height measurements are described. The different heights for the base and top of the auroræ, illuminated by the sun, or in the earth's shadow, are summarised. Finally reference is made to the " Photographic Atlas of Auroral Forms," and the results it is hoped to obtain during the present polar year from the many auroral stations. R. S. R.

2305. Kinematographic Results of Measurements of Height and Proof of Infra-Red Radiation of the Aurora. W. Bauer. *E.N.T.* 10. *pp.* 68–72, *Feb.*, 1933.—The author obtained a parallactic record from two stations of the developments in space and time of auroral phenomena and so hoped to connect these with height oscillations of the Heaviside layer and with rapid magnetic disturbances. Tests were made with four objectives to find which could be used for the shortest exposure and methods of sensitisation of the photographic plates and films were varied. He obtained with the apparatus four pictures per sec. The rapid development of draperies is shown in plates. The method permitted tests to be made in the infra-red, and by comparison of the results on a red arc, with the nitrogen spectrum, bands due to molecular nitrogen were recognised. In one case the auroral base was found at only 65 km. in the infra-red. R. S. R.

See also Abstracts 2286, 2288, 2542, 2543.

RADIOACTIVITY.

2306. Determination of Uranium and Thorium in Rocks. H. Gräven. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 515–520, 1932.—The preparation of a standard consisting of an artificial rock containing a known quantity of pitchblende, ThO_2 or thorite is described. It is shown that the amount of water in such a solid standard has no appreciable effect on the measurements. The activity of a specimen of rock obtained by measurements on a polished surface is shown to be definitely lower than that obtained from measurements of a natural surface. W. E. P.

2307. Radioactivity of New Pre-Cambrian Granite of South Finland. H. Gräven and G. Kirsch. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 521–528, 1932.—The paper gives the detailed results of the measurements of the uranium and thorium contents of a number of granite specimens. The general nature of the results is discussed. W. E. P.

2308. Microscopic Investigation of a Crystal of a Morogoro Ore. H. Haberlandt. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 529–531, 1932.—A crystal of a morogoro ore was examined in sections microscopically, its luminescence under the action of ultra-violet light was observed and a radiograph was prepared from the largest section. The zones thus distinguished are described and the results are compared with other investigations of the same crystal. [See Abstract 484 (1932).] W. E. P.

2309. Direct Fusion Method for Determining the Radium Content of Rocks. R. D. Evans. *Rev. Sci. Instruments,* 4. *pp.* 223–230, *April,* 1933.—New principles for removing radon from rocks and for measuring minute quantities of radon are presented. Powdered rock specimens are boiled without flux by direct heating in an evacuated, graphite-resistance furnace. The duration of heating is 2½ min. which is to be compared with about one hour for the quickest of former methods. The gases from the melt are led to the ionisation chamber through an electrostatic ion-trap. A small insulation drying device in the ionisation chamber protects the amber from water vapour. The natural observational limit for measurements of small quantities of radon is defined as the point at which the average ionisation from the radon just equals the probable statistical variation in the background ionisation due to cosmic and local radiation, and an apparatus is described which permits measuring radon down to this limit. A string electrometer measures only the difference in ionisation in two identical ionisation chambers, both of which contain the same background gases, but only one of which contains the radon to be measured. A systematic study of the percentage of the total radon removed from biotite granite as a function of (*a*) temperature, (*b*) duration of heating, (*c*) fineness of sample grains, showed that temperature is the only important factor, and that 1800° C. effects complete radon removal. AUTHOR.

2310. Radium Content of Ocean-Bottom Sediments. C. S. Piggot. *Am. J. Sci.* 35. *pp.* 229–238, *March,* 1933.—The average radium content (in $g \times 10^{-12}/g.$) of 28 samples of such sediments (1 in the Atlantic, 27 in the Pacific) is 6·52 (1·80 — 21·40), as compared with 17·8 (3·1 — 52·6) for 12 determined by Joly, and 10·96 (1·4 — 49·5) for 20 examined by Pettersson. Red clay has usually the highest content. It is suggested that the high content of these sediments is due to precipitation of uranium as oxide through the larger amount of oxygen at great depths; the uranium becoming relatively concentrated by reason of the very small amount of other sediments far from land. C. A. S.

2311. Parent of Protactinium. O. A. Gratias and C. H. Collie. *Roy. Soc., Proc.* 139. *pp.* 567–575, *March* 3, 1933.—The paper describes the preparation of a source of UY free from ekatantalum and the separation of the ekatantalum formed from the UY. The ekatantalum formed was found to be an α-particle-emitting radio element having similar chemical properties to Pa. The half-value period obtained by direct measurement is sufficiently close to that of Pa to support the view that UY is the parent of Pa. W. E. P.

2312. New Radioactive Substances. A. Debierne. *Comptes Rendus,* 196. *pp.* 770–771, *March* 13, 1933.—If a barium preparation containing radium be fractionated repeatedly either by precipitation of the carbonate or crystallisation of the bromide, marked differences in the activity time curves of the head and tail fractions are observed. It is suggested that this is due to formation of neoradium (NeRa) thus: Ra $\xrightarrow{\gamma}$ NeRa $\xrightarrow{\alpha}$ Ra, and that this is the explanation of peculiarities in the magnetic spectrum of, and the emission of β-rays by radium. [See Abstracts 2897 and 4372 (1932).] C. A. S.

2313. Theoretical Decay Curves for Various Ratios of Radium-B to Radium-C, and of Thorium-B to Thorium-C. J. A. Cranston and C. Benson. *Roy. Techn. Coll. Glasgow, J.* 3. *pp.* 47–51, *Jan.,* 1933. —Curves are drawn showing the theoretical rate of decay of the α activity for various initial proportions of (i) radium-B and radium-C, and (ii) thorium-B and thorium-C. Additional curves are given to determine these initial proportions by measurements carried out at intervals that are likely to be convenient experimentally. AUTHORS.

2314. Radioactivity Measurements. Part I. Radium Content of Keweenawan Basalts and Accessory Minerals. Part II. Occurrence of Radium, Uranium and Potassium in the Earth. W. D. Urry. *Am. Acad., Proc.* 68. 4. *pp.* 125–144, *March,* 1933.—The radium content ($\times 10^{13}$ gm./gm.) of 13 samples of basalt of the Keweenawan series averaged 1·29 (0·33 – 4·16), two felsites contained 4·71 and 7·00, datolite and prehnite associated with the copper ores 1·10 and 0·18, and three arsenical copper ores averaged only 0·10. The older flows generally contained < the younger, the base of a flow < the top, and the more basic rock < the less basic; and there is definite non-association of radium with copper. The following is an estimate of the amounts of radium, potassium and thorium in the earth (that of uranium is $3 \times 10^6 \times$ amount of radium):

Shell	Radial thickness km.	Mass gm. $\times 10^{27}$	Radium		Helium ann. product gm. $\times 10^{12}$	Potassium gm. $\times 10^{21}$	Thorium[g] gm. $\times 10^6$ per gm.
			gm. $\times 10^{13}$ per gm.	Total gm. $\times 10^{11}$			
Central core	3400	1·646	0·25[a]	411	14·30	—	—
Ferrosporic	700	0·513	0·7[b]	359	12·41	—	?
Lithosporic	700	1·360	1·2[c]	1632	56·78	1903	?
Peridotitic	1540	2·417	2·0[d]	4834	168·19	5317	1
Basaltic	40	0·065	2·8[e]	182	6·33	832	2
Granitic	20	0·029	14·0[f]	406	14·13	754	10
Whole earth	6400	6·030	—	7824	272·14	8806	—

a, *c*, *d*, average content respectively of 22 iron, 20 chondritic, and 20 achondritic meteorites ; *b* mean of *a* and *c* ; *e* content of Daly's " average basalt " ; *f* weighted mean of best recent results ; *g* rough estimate. These quantities give heat and helium evolution in good agreement with Holmes' theory of convection currents in the substratum. C. A. S.

2315. Factors Affecting the Ratio of Adsorption of Radium-B and Radium-C on Nickel. J. A. Cranston and C. Benson. *Roy. Techn. Coll. Glasgow, J.* 3. *pp.* 52–56, *Jan.*, 1933.—An apparatus has been devised to obtain the active deposit from radon when contained in capillary tubes or " seeds " as supplied to the medical profession. It is shown that the ratio of radium-C to radium-B adsorbed on nickel when immersed in a solution containing both elements increases progressively with the acidity. The electrode potential existing between the nickel and the solution is found to be a minor factor in determining the ratio of radium-B to radium-C adsorbed, whether the electrode potential is established in electrochemically indefinite or in electrochemically definite systems. The rate of change of electrode potential of nickel when immersed in $N/1000$ HCl has been measured. AUTHORS.

2316. Radioactivity of a Fraction from a Neodymium-Samarium Mixture : Element 61. M. Curie and S. Takvorian. *Comptes Rendus*, 196. *pp.* 923–925, *March* 27, 1933.—Five kilogrammes of the mixed oxides of neodymium and samarium were fractionated ; although the middle fractions when examined with the spectroscope showed no trace of element 61 they emitted a radiation which was more penetrating than that attributable to samarium, and which was a maximum in the fraction in which element 61 was to be expected. Neodymium and lanthanum are not radioactive. C. A. S.

2317. Evaporation Experiments on Polonium. Elisabeth Rona. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 533–537, 1932.—Evaporation experiments are made on polonium sources situated on bases of Au, Pt and Pd. It is found that much higher temperatures are required for evaporation from Pd. Old and new sources of Po on Au show markedly different evaporation curves, the older the source the less being the amount of evaporation. This is associated with the interpenetration of the Po into the Au base. On the other hand, sources on Pd show little alteration with age and it is concluded that the Po either remains as a strongly bound surface layer or else it penetrates the Pd from the commencement. Range measurements by the cloud method are in progress to test these hypotheses. The behaviour with Pd is probably closely connected with the formation of well-defined hydrides by both Po and Pd. F. C. C.

2318. Saturation Pressure of Radon at Low Temperatures. L. Wertenstein. *Acta Physica Polonica*, 2. 1. *pp.* 131–136, 1933. *English Abstract.*—Determined by a specially designed apparatus the pressure p of saturated vapour of radon at 90° Abs. (temperature of boiling oxygen) is 0·05 bar, and its variation is given fairly well by the relation $\log p = C - (A/T) - 0{\cdot}5 \log T$, whence the heat of vaporisation of solid radon is deduced as 4360 cal. per gm. atom. C. A. S.

2319. Ranges of α-Rays of the Actinium Series. F. Rieder and Elisabeth Rona. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 493–500, 1932. —The results of determinations of the ranges of the α-rays from RaAc, AcX, AcC, AcEm and AcA by means of the Wilson method are given and discussed. W. E. P.

2320. Measurement of the Range of α-Particles from Thorium with the Wilson Chamber. F. N. D. Kurie and G. D. Knopf. *Phys. Rev.* 43. *pp.* 311–314, *March* 1, 1933.—The range of the α-particles from thorium has been measured by the methods used by one of the authors previously [see Abstract 557 (1933)]. At 0° C. and 760 mm. the extrapolated number-distance range is $2\cdot72\pm0\cdot03$ cm. This range is derived from 300 tracks. It is pointed out that the great deviation of this range from that of Henderson and Nickerson is partially due to these authors' treatment of their data. The Geiger-Nuttall law is shown in the form indicated by Gamow's theory, and the latest data for the uranium and thorium series pertaining to it are given. AUTHORS.

2321. Ionisation of Single H-Particles in Different Gases. J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 9–10. *pp.* 539–551, 1932.—Using the valve electrometer, the ionisation per cm. produced by natural H-particles (from paraffin wax by bombardment with α-particles from Po) of remaining range 7·1 cm., is investigated in different gases. The results are :

Gas.	*Relative Ionisation*	*Number of Ion Pairs at 760° and 0°C.*
Air	1·000	6500
CO_2	1·51	9800
N_2	0·92	5900
O_2	1·15	7400
H_2	0·200	1290
He	0·200	1290

Comparison with known results for α-particles shows approximate agreement of the relative values. Considering the experiments as a whole, no marked abnormalities occur in the values for the ionisation of H-particles in different gases. F. C. C.

2322. Analysis of α-Rays by an Annular Magnetic Field. (Lord) Rutherford, C. E. Wynn-Williams, W. B. Lewis and B. V. Bowden. *Roy. Soc., Proc.* 139. *pp.* 617–637, *March* 3, 1933.—Previous experiments [see Abstract 3796 (1932)] are extended by the construction of an electromagnet producing a uniform annular field in which α-rays are bent into a circle of 40 cm. radius, which enables the well-known focussing properties to be used. The interior of the whole magnet is exhausted to a low pressure. The particles are emitted from a source placed in the gap, and are detected by a small ionisation chamber situated at the other end of the diameter. The ionisation chamber is connected to an amplifier and individual α-particles are counted by a system of thyratrons. The analysis is carried out by adjusting the magnetic field so as to bring groups of different velocities successively on to the slit of the ionisation chamber. It is necessary to measure the magnetic field with great accuracy during the experiments and a very satisfactory method is developed for this purpose. It is possible to determine the relative velocities of a number of important α-ray groups with an accuracy of about 1 in 5000. It is shown that the weak group from RaC, numbering only 1 in 4000 of the main RaC′ group, comprises two distinct components. The main long range groups from ThC′ and RaC′ are observed and experiments are now in progress to complete the examination of the weaker groups from radium C′. It is found that the differences of energy between the main group and two of the long range groups from RaC′ are in close agreement with the energies of α-rays found by Ellis. F. C. C.

2323. Relative Velocities of the α-Particles from Thorium X and its Products and from Radium C′. G. H. Briggs. *Roy. Soc.. Proc.* 139. *pp.* 638–659, *March* 3, 1933.—By the direct magnetic deflection method the relative velocities of the α-particles from thorium X, thoron, thorium A, thorium C (mean), thorium C′, and radium C′ are measured with a probable error of 1 in 20,000. Preliminary results for the relative velocities of the α-particles from radon and radium A, accurate to about 1 in 2000, are given. These results are combined with the range measurements of Lewis and Wynn-Williams [see Abstract 3796 (1932)] to give the relation between velocity and the range for α-particles of ranges between 4 and 9 cm. It is found that for ranges greater than 5 cm. this relation is accurately given by $V^{3.26} = kR$. The corrections for loss of velocity due to absorption at the source are fully discussed. F. C. C.

2324. Quantitative Theory of Radioactive α-Emission. T. Sexl. *Zeits. f. Physik,* 81. 3–4. *pp.* 163–177, *March* 11, 1933.—The quantitative theory of radioactive α-emission is given according to the method of calculation of complex characteristic proper values. J. J. S.

2325. Nuclear Scattering of β-Particles. T. Sexl. *Zeits. f. Physik,* 81. 3–4. *pp.* 178–185, *March* 11, 1933.—On the basis of Dirac's equations the nuclear scattering of β-particles is calculated by Born's approximation process with limitation to the first approximation. J. J. S.

2326. Maximum Energy of the β-Rays from Uranium X and Other Bodies. B. W. Sargent. *Roy. Soc., Proc.* 139. *pp.* 659–673, *March* 3, 1933.—The end-points of the β-ray spectra of several of the radioactive elements are determined by the absorption method using an electroscope, together with absorbers of paper and aluminium. The end-point of the normal spectrum of the β-rays from uranium X is found to occur at $2 \cdot 32 \times 10^6$ volts. A search is made for β-rays having energies from 3 to 7 million volts, but none is found and an upper limit to their number is determined. A critical survey of the data on the end-points of β-ray spectra is given, together with a list of preferred values. It is shown that a relation appears to exist between the maximum energy emitted in a β-ray spectrum and the disintegration constant. F. C. C.

2327. Relation between β-Ray Absorption by Organic Compounds and their Molecular Structure: Halogen Derivatives. G. Fournier and M. Guillot. *Comptes Rendus,* 196. *pp.* 698–700, *March* 6, 1933.—Results for 18 halogen substitution compounds show that the difference Δ between the observed and calculated mass absorption coefficients is increased, by an approximately constant amount, by the substitution of halogen for hydrogen atoms in hydrocarbons, the increase being greater for bromine than for chlorine. Successive replacement, in the same molecule, of hydrogen by halogen atoms results in a uniform increase of Δ. The influence on Δ of a lengthening of the carbon chain or introduction of a double bond is similar to that found for hydrocarbons [see Abstract 1830 (1933)]. The value of Δ in the little-ionised organic compounds approximates more closely to Δ for pure bromine than for the easily ionised inorganic bromides. N. M. B.

2328. γ-Ray and X-Ray Spectra of the Thorium Family. M. Valadares. *Comptes Rendus,* 196. *pp.* 856–858, *March* 20, 1933.—Using the crystal diffraction method [see Abstract 3588 (1929)] and (*a*) a metal plate activated with thoron, or bulbs containing (*b*) mesothorium, or (*c*) radiothorium, the γ-ray spectra included the lines 103, 143, 160 and 165X from (*a*), (*b*) and (*c*); 285, 320, 330, and 387 from (*b*) and (*c*); and 118 only from (*b*). 103, 285, 320 and 330 are the second order lines corresponding to 52, 143, 160 and 165 respectively. Three faint lines appeared between 165 and 285; 143 is a doublet (139 and 143), probably due to ThB → ThC; 160 and 165 belong to $K\alpha_1$ and $K\alpha_2$ of element No. 83. C. A. S.

2329. Entry of the Disintegrating α-Particle into the Nitrogen Nucleus and a General Relation between Heights of Nuclear Barriers and Atomic Number. E. C. Pollard. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 357–358, *Jan.*, 1933.—A previous experiment [see Abstract 4367 (1932)] has been repeated at smaller absorptions and with a thicker layer of nitrogen. A height of $4 \cdot 3 \times 10^6$ electron volts is found for the nitrogen potential barrier. A flattening of the absorption curve also occurs corresponding to this value. Experiments at small proton absorptions indicate a virtual α-particle level where entry by resonance can take place. Evidence from various sources is stated to show that the height of the potential barrier is approximately proportional to the atomic number, except for the very lightest elements. W. E. P.

2330. Recent Researches upon the Transmutation of the Elements. (Lord) Rutherford. *Roy. Inst., Proc. Advance Proof.* [5 *pp.*], *received April*, 1933. *Abstract. Nature*, 131. *pp.* 388–389, *March* 18, 1933. *Abstract.*—An account is given of recent work upon artificial disintegration including new work upon the use of high-speed protons artificially produced. It has been found possible to observe disintegrations of the lithium nucleus produced by protons with energies as low as 30,000 electron volts. It has not been possible to find any effect upon the heavy elements. J. E. R. C.

2331. Theory of Atomic Nuclei. Part II. E. N. Gapon. *Zeits. f. Physik*, 51. 5–6. *pp.* 419–424, *March* 22, 1933.—In a previous paper [see Abstract 992 (1933)] the author has discussed the periodic system from helium to argon. In the present paper the discussion is extended to neodymium and certain underlying principles are deduced. J. E. R. C.

2332. Emission of Neutrons from Beryllium. G. Kirsch and F. Rieder. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 501–508, 1932.—α-Particles of known range are allowed to fall upon a sheet of beryllium and the neutron emission is detected by the tertiary protons liberated from water. The protons are observed in a Shimizu apparatus. By varying the energy of the incident α-particles the excitation function of the beryllium nucleus has been found. Three kinks in the curve connecting the number of tertiary protons with the range of the α-particles have been found and it is deduced that these correspond either to four resonance levels of the beryllium nucleus or to three resonance levels and the top of the potential barrier. The characteristic energies are given as $5 \cdot 57 \times 10^{-6}$, $5 \cdot 0 \times 10^{-6}$, $4 \cdot 43 \times 10^{-6}$ and $3 \cdot 0 \times 10^{-6}$ erg. J. E. R. C.

2333. Photographic Detection of Protons Liberated by Neutrons. Part II. Marietta Blau and Hertha Wambacher. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 9–10. *pp.* 617–620, 1932.—Whereas the particles produced by α-particle impact may be recorded on an ordinary process plate, those liberated by neutrons do not record unless the plate is previously desensitised by means of pinakryptol yellow; if this is done a quantitative record is obtained. The photographs described indicate higher neutron energies than have hitherto been reported. H. F. G.

2334. Neutron, Atom Building and a Nuclear Exclusion Principle. W. D. Harkins. *Nat. Acad. Sci., Proc.* 19. *pp.* 307–318, *March*, 1933.—The paper commences with an account of the discovery of the neutron, and points out that neutrons in our universe constitute a new element of atomic number zero which is of fundamental importance in the formation of other elements and should be found in space with a moderately high relative concentration, *i.e.*, as compared with the other elements in space. From the emission of γ-rays by nuclei excited by neutrons, the author describes the present status of the experimental work on the disintegrative synthesis of atoms or disintegration by capture as follows: (1) α-Particle of double charge and small excess mass. Kinetic energy seems to be transformed into mass (possibly into γ-radiation). (2) Proton of single charge and high excess mass. Excess mass seems to be converted almost entirely or entirely into kinetic energy or partly into some other form of energy (as γ-rays). (3) Neutron of zero charge and high excess mass. Excess mass may disappear and presumably escapes as γ-rays. Kinetic energy may also be, and usually is, converted into γ-rays. Thus far, when an α-particle has gone into a heavier nucleus a proton or a neutron has come out, and when a proton or a neutron has gone in an α-particle has come out. The author then discusses the structure of the nucleus, exclusion principles, the binding energy of nuclear groups, and the emission of neutrons as related to the Harkins-Masson formula. H. H. Ho.

2335. Spontaneous Neutron Emission? S. Pieńkowski and J. Starkiewicz. *Acta Physica Polonica*, 2. 1. *pp.* 105–110, 1933. *In French.*—A. Dorabialska has reported the spontaneous emission of neutrons from certain elements. The author has repeated her experiments with the elements Sb, Bi, La, Sc, Na, F and As. The experimental conditions were carefully controlled and were more favourable for the effect, but no effect was observable. It is concluded that the neutrons, if emitted, cannot have energies greater than a few hundred electron volts. J. E. R. C.

2336. Spontaneous Neutron Emission? H. Herszfinkiel and A. Wroncberg. *Acta Physica Polonica*, 2. 1. *pp.* 157–159, 1933. *German Abstract.*—The author has looked for a possible neutron emission from F, Bi and K. There was no radiation from these elements able to pass through copper foil or paraffin. Special attention was paid to potassium in view of the possibility of its natural γ-radiation being associated with neutron emission but no effect was observable. J. E. R. C.

2337. Positive Electron. C. D. Anderson. *Phys. Rev.* 43. *pp.* 491–494, *March* 15, 1933.—Reproductions are given of the original Wilson chamber photographs which showed tracks due to particles carrying a positive charge and having a mass of the same order of magnitude as that of an electron. Out of 1300 photographs of cosmic-ray tracks, there were 15 tracks attributable to such particles. From the ionisation produced and the energy loss in a lead plate, the positive charge is estimated to be less than double, and probably exactly equal to that of the proton. As upper limit to the mass, a value of about twenty times that of the negative electron is derived. From the fact that these particles (positrons) occur in groups associated with other tracks it is concluded that they must be secondary particles ejected from atomic nuclei. Possible relations between proton, electron, neutron and positron are discussed. W. S. S.

2338. New Evidence for the Positive Electron. J. Chadwick, P. M. S. Blackett and G. P. S. Occhialini. *Nature*, 131. *p.* 473, *April* 1, 1933.—New experiments are described which support the evidence for the existence of a positive electron [see also Abstract 2382 (1933)]. The radiation from Be excited by α-particle impact is allowed to fall upon a lead target situated in an expansion chamber. By deflecting the particles emitted from the lead it appears that they have electronic mass but positive charge. This is confirmed by allowing the particles to pass through an absorbing sheet also situated in the expansion chamber, and from the change of energy produced showing that they almost certainly proceed from and not towards the lead. J. E. R. C.

2339. Apparatus for the Measurement of Radioactive Materials. A. Piccard and L. Meylan. *J. de Physique et le Radium,* 4. *pp.* 105–108, *Feb.,* 1933.—The apparatus consists of an ionisation chamber formed by two plane parallel plates of large area, a lead disc of uniform thickness being placed on the upper plate. The preparation is placed at the centre of the lead disc. The effect of a small displacement of the preparation decreases with the thickness of the lead. With a lead thickness of 1 to 2 cm. an uncertainty of 4 cm. in the position of the preparation causes an error of less than 0·3 %. W. E. P.

2340. Emanation Content of the Atmosphere, Meteorological Factors and Cosmic Radiation. W. Messerschmidt. *Zeits. f. Physik,* 81. 1–2. *pp.* 84–100, *March* 3, 1933.—A method for the determination of the emanation content of the atmosphere is described which is based on a direct measurement of the conductivity of the outer air compressed in an ionisation chamber. The measurements were carried out in Halle. They show a daily course of the emanation content which is opposite to the variation of the temperature. This is due to the thermal convection currents of the atmosphere. The magnitude of the oscillation of the emanation content accords with the daily amplitude of the temperature and so also with the character of the weather. The yearly average amounts to about 300×10^{-18} curie/cm^3. A maximum occurs in April and May due to warming and gradual drying of the earth's surface. With falling air pressure without precipitations the emanation content rises, it sinks when rain comes on. With increasing air pressure and improvement of the weather the emanation content grows larger. Greater wind velocities through quicker mixing of the layers of air have as a consequence a decrease of the emanation content. Sea air is poorer in emanation than continental air. An influence from humidity of the air does not exist. Between the heights of 18 m. and 37 m. above the earth's surface no difference in the emanation concentration was observed. With unsheltered exposure of a thin-walled ionisation chamber for cosmic-ray measurements the influence of the emanation content of the atmosphere is not to be underestimated. The observations of the cosmic radiation in Halle were not impaired by the small shield openings. J. J. S.

2341. Radioactive Phenomena of the Second Order, Artificially Induced. G. Reboul. *J. de Physique et le Radium,* 4. *pp.* 73–89, *Feb.,* 1933.—Gives details how to obtain substances presenting great analogies with natural radioactive substances, since they affect the photographic plate, ionise gases, and produce phosphorescence effects. These radioactive effects of the second order are due to electrons of the peripheral orbits of the atom ; the corresponding radiations are exceedingly absorbable ; the wave-lengths of the radiations are between some tenths and some hundredths of an Ångström, and their energy-quantum ranges from some hundredths to some tenths of a volt. A. D.

See also Abstracts 2105, 2204, 2541, 2546.

RADIATION.

ABSORPTION AND TRANSMISSION.

2342. Natural Blue Rock-Salt. K. Przibram. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 9–10. *pp.* 567–569, 1932.—Further pictures are given of blue rock-salt [see Abstracts 1805 (1930) and 420 (1931)] which show the formation of diffusion haloes and the arrangement of the colour according to zones of growth and at surfaces of slipping. The connection of blue coloration and sylvine is also shown. J. J. S.

2343. Recrystallisation and Coloration. Part III. Dependence of Colour and Recrystallisation on Pressure and Strain. K. Przibram. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 639–643, 1932.—The blue colour change of compressed irradiated rock-salt [see Abstract 420 (1931)] may be followed down to a loading of 100 kg. per sq. cm. and a strain of about 2 %. The velocity of recrystallisation must be regarded as a function rather of the strain than of the pressure. The repression of the recrystallisation by irradiation previously observed has been verified by further experiments with specimens subjected to pressures of 10,000 (or more) kg. per sq. cm. and also with potassium chloride and bromide. The bromide displays particularly rapid recrystallisation. T. H. P.

2344. Absorption of Metals in the Visible and Ultra-Violet. H. Fröhlich. *Zeits. f. Physik*, 81. 5–6. *pp.* 297–312, *March* 22, 1933.—It is shown that in metals, the quantity $\sigma\nu = n\,k\,\nu^2$ (σ = conductivity, n = refractive index, k = absorption coefficient, at frequency ν) is proportional to the transition probabilities of the electrons. It allows of the exact recognition of the energy bands of metals, and from the experimental data for the frequency variations of n and k the position and width of these bands or the forbidden energy regions can be determined. From known data, the width of the first forbidden regions for Cu, Ag, and Au are calculated. The value of $\sigma\nu$ shows that for these metals, the eigenfunctions of the electrons differ much more from those of free electrons than in the case of the alkali metals. C. B. A.

2345. Transmission of Light through Cloud Particles. D. Nukiyama and A. Kobayasi. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 92. *pp.* 307–338, *Feb.*, 1933. *In English. Phys. Math. Soc., Japan, Proc.* 15. *pp.* 59–72, *Feb.*, 1933.—Further studies have been made on lines similar to those described earlier [see Abstract 4920 (1932)], clouds being obtained from incense and four other substances. The observations were made with different cloud densities, and curves show for each substance the relations of transmission with wave-length and cloud density. Two maxima are obtained in the transmission wave-length diagrams which may be due to the complex nature of the combustion products. Rayleigh's scattering formula is inapplicable on account of the particle size and the formula should contain the reflecting power, refractive index and absorption coefficient of the particle. The radii of the particles were determined and were found not to be related to the position of the second maximum of transmission. The first maximum appears to shift to higher wavelengths as the particle radius increases, the increase being 800 Å for an increase of radius of 10^{-4} cm. In a table are given the radius of the particle and the wave-lengths for the two maxima and the minimum for each of the five substances tested and for the maximum for water and NH_4Cl. R. S. R.

2346. Infra-Red Content of Daylight. G. B. Harrison. *Phot. J.* 73. *pp.* 1–3, *April,* 1933 (*Supplement*).—An apparatus is described which records from day to day the fluctuations that occur both in the visible and infra-red constituents of daylight, the intensities of the radiations received being measured by two light-sensitive cells, both of the copper-cuprous oxide type. The records so far obtained show that infra-red rays pass less readily through light cloud and more readily through light fog than visible rays. H. H. Ho.

2347. Sonic Nephelometer. J. S. Wilson. *Journ. Sci. Instruments,* 10. *pp.* 97–101, *April,* 1933.—An instrument is described for the comparison of light transmitted by translucent materials, in which a photo-electric cell is employed to detect differences in the intensity of two light beams illuminating the kathode alternately after having passed through the material under test. A brief discussion of the sensitivity of the method is given and some applications are suggested. AUTHOR.

See also Abstracts 2204, 2351, 2377, 2434, 2438.

COLORIMETRY.

2348. Colour Description. E. Haschek and M. Haitinger. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 9–10. *pp.* 621–631, 1932.—Describes a method of expressing the colour of a material in terms of the coordinates of the point which represents that colour on the ordinary equilateral colour triangle. A method of determining the various quantities required is given, and a number of experimental results are tabulated. J. W. T. W.

2349. Optically Stable Sugar Solutions for Colorimetric Analysis. J. F. Brewster and F. P. Phelps. *Bureau of Standards, J. of Research,* 10. *pp.* 365–372, *March,* 1933.—The successful application of colorimetry in the sugar industry is dependent upon the development of a satisfactory technique for preparing sugar solutions having a satisfactory degree of transparency. In the present paper existing methods have been revised. The process of clarification has been shortened and the transparency of the solutions improved. These results have been accomplished by increasing the concentration of the dry substance or total solids, dissolving and filtering the sugar products hot, and developing the application of better filters. In addition, other details of manipulation have been improved. AUTHORS.

2350. Duboscq Instrument for Colorimetry, Nephelometry and Colorimetric Determination of Hydrogen-Ion Concentrations. J. Grant and J. H. W. Booth. *Journ. Sci. Instruments,* 10. *pp.* 106–110, *April,* 1933.—A simple and inexpensive device is described for the rapid conversion of a simple Duboscq colorimeter into a nephelometer of such an accuracy as to be capable of determining 10^{-6} *N* KCl solution with an accuracy of 5 %. The same instrument has also been adapted to the colorimetric measurement of H-ion concentration with an error of 0·01 *p*H. A permanent inorganic colour standard for the bromo-thymol-blue range (*p*H 6·0–7·6) is described with a mean error of 0·015 *p*H in this instrument. AUTHORS.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2351. Transversal Magneto-Optical Anisotropy of Vanadium Pentoxide Sols. W. Heller and H. Zocher. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 55–80, *March,* 1933.—Vanadium pentoxide sols exhibit, irrespective of their age, positive magnetic double refraction and dichroism, both in atactosols and in dilutions of tactosols. In normal sols with fine particles, the double refraction increases with the square of the field, and deviations from this law only begin when the particles are extremely coarse. The effect of breaking up of particles on dilution of the sol was again observed magneto-optically. At sufficiently small ζ-potentials, natural sols can be coagulated mechanically, with a considerable increase in the magneto-optical anisotropy, and development of strong double refraction. The anisotropy is not affected by temperature. The processes of orientation and disorientation of the particles in the field proceed according to a simple logarithmic relationship with time, and this also is unaffected by temperature. C. B. A.

2352. Anomalous Dispersion of Magnetic and Electric Double Refraction. R. Lucas and M. Schwob. *Comptes Rendus,* 196. *pp.* 765–767, *March* 13, 1933.—The dispersions of the magnetic and electric double refractions between wave-lengths 4358 and 5780 Å of *r*-fenchone are 0·75 (at 16·5°) and 1·30 (at 20·5°), and of ethyl *r*-phenylsuccinate 1·39 (at 18°) and 1·05 (at 24°) respectively. Havelock's law is not obeyed. The electric double refraction temperature curve for λ 5780 between 15° and 30° of ethyl *r*-phenylsuccinate is abnormal. These results indicate the presence in both substances of two forms in equilibrium.

C. A. S.

2353. Faraday Effect in Paramagnetic Solutions. C. J. Gorter. *Phys. Zeits.* 34. *pp.* 238–241, *March* 15, 1933.—The following results are derived from an examination of the results of other workers and of some new measurements: (1) The molecular-rotations of rare-earth salts appear to be independent of concentration at wave-lengths removed from absorption bands: those of ferric salts show large variations; (2) Solutions of Ce, Pr, and Nd salts satisfy the Curie-Weiss law for temperature-variation of rotation; (3) The rotatory dispersions can be related to known absorption bands. In the case of Ce, one of these can be associated with the transition $4^2F_{\frac{5}{2}} \rightarrow 5^2D_{\frac{3}{2}, \frac{5}{2}}$; (4) In the iron group the rotations are smaller and their origin is less clear. C. B. A.

2354. Faraday Effect in a Camphor Derivative. J. Verhaeghe. *Comptes Rendus,* 196. *pp.* 850–852, *March* 20, 1933.—Describes the results of a study of the magnetic rotation of the plane of polarisation for diphenyl-methylene-camphor, using hexane as the solvent. The field strength used was 15,000 gauss. The rotation observed was positive for all wave-lengths within the region studied (0·44 to 0·67 μ). J. W. T. W.

See also Abstract 2576.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2355. Theory and Practice of Fluorescence Measurements. Part I. Intensity-Time Course of Fluorescence Excited by Intermittent Light. Part II. General Theory of Fluorometers. F. Duschinksy. *Zeits. f. Physik,* 81. 1–2. *pp.* 7–22, *March* 3, 1933.—In the first paper a solution is given for the intensity-time course of the light emitted by a simple classical oscillator. A relation is obtained between the Fourier coefficients of the exciting light and the corresponding periodic function of the emitted light. In the second paper these results are applied to show how the experimental results obtained with, for instance, a Gaviola fluorometer may be interpreted. J. E.

2356. Testing the Polarisation of the K-Radiation of the X-Ray Fluorescence of Anisotropic Single Crystals. M. Groos. *Ann. d. Physik*, 16. 5. *pp*. 541–559, *March*, 1933.—Assuming that the anisotropy of certain crystals is due to the electronic envelopes of the atoms that constitute the crystals not being spherically symmetrical, the author examines the polarisation of the K-fluorescence-radiation of these crystals. A photographic investigation shows that in the case of single crystals of TiO_2 and Zn the expected effect does not occur ; nor is it possible to arrive at a result in the case of γ-γ-dibromo-anthracene (which has been examined by Stark) which becomes fully decomposed by the action of the X-rays. The working of the apparatus was carefully checked and found to be unobjectionable. H. L. B.

2357. Investigation of the Glow of Phosphorus with the Aid of a Photoelectric Counter. C. Ouellet. *Faraday Soc., Trans*. 29. *pp*. 486–494, *March*, 1933.—A description is given of the construction of a sensitive photoelectric counter, with which the kinetics of the oxidation of phosphorus has been examined. No radiation of wave-length less than 2800 Å is found to be emitted outside the explosive limits as defined by Rayleigh and Semenoff. With regard to the effect of change in the pressure of the oxygen on the glow, the variation in intensity of the radiation emitted is found to follow that anticipated from a chain mechanism of a type proposed by Semenoff. The glow is shown to be composite, and it is suggested that two chemical reactions, in sequence and unequally affected by the gas pressure, are involved. T. H. P.

2358. Luminescence of Fluorites. H. Haberlandt. *Akad. Wiss. Wien, Ber*. 141. 2*a*. 5–7. *pp*. 441–447, 1932.—Gives the results of a detailed investigation of the luminescence of fluorites obtained from a large number of sources. J. E.

2359. Luminescence and Crystal Structure. B. E. Cohn. *Am. Chem. Soc., J*. 55. *pp*. 953–957, *March*, 1933.—Zinc borate glasses have been prepared showing both thermoluminescence and fluorescence under ultraviolet light. Though the spectrum appears to be the same for both types of luminescence, the optimum concentration is different for each, a result which is not in accord with the theory of Ewles that the optimum concentration determines the size of the centre, or with any crystal structure theory of luminescence. J. E.

2360. Luminescence of Alkaline Earth Tungstates Containing Lead. F. E. Swindells. *J.O.S.A*. 23. *pp*. 129–132, *April*, 1933.—Lead is shown to be an activator for the phosphorescence of calcium and strontium tungstates, the optimum concentration being about 0·01 mol. of $PbWO_4$ per mol. of alkaline earth tungstate. In addition, it was observed that much higher concentrations of lead produce an enormous increase in both the fluorescent and phosphorescent power of strontium tungstate. The optimum concentrations of lead for this effect are 0·2 and 0·4 mol. fraction for the fluorescence and phosphorescence, respectively.

High concentrations of lead in calcium tungstate serve only to decrease the luminescent power. AUTHOR.

See also Abstracts 2308, 2432.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2361. Colour in Films of Sputtered Tin. C. J. Overbeck. *J.O.S.A.* 23. *pp.* 109–113, *March*, 1933.—Films were sputtered on glass from circular tin kathodes. These films, when produced in air or oxygen and viewed with monochromatic light, show alternately light and dark rings ; in white light they show several cycles of the colours of the visible continuous spectrum, similar in appearance to Newton's rings. In the formation of a set of rings the centre gradually passes through a cycle of colours of increasing wave-length to the red. The red centre then merges into blue and the cycle is repeated. With the appearance of each new centre colour, all preceding colours move outward and form surrounding rings. The rate of growth of a set of rings depends on the sputtering conditions. Under proper conditions, the change of colour of the centre and the addition of another set of colour rings takes place with definite regularity. These colours are believed to be due to an interference effect produced by the variation in thickness of the film layer. This layer is probably stannic oxide. Films produced in nitrogen are opaque brown deposits. Tests indicate the material of these films to be a tin-nitrogen compound. Heating such a film in oxygen produced a nearly transparent colour film similar to those sputtered in oxygen or air. Films produced in hydrogen have mirror surfaces of high reflecting power. AUTHOR.

See also Abstracts 2347, 2350, 2396, 2449.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2362. Photochemistry of Phosphine. Part III. H. W. Melville. *Roy. Soc., Proc.* 139. *pp.* 541–557, *March* 3, 1933.—At atmospheric pressure and room-temperature phosphine shows continuous absorption from 2250 Å to 1850 Å (or beyond), and in addition 4 very faint diffuse bands, of 10–20 Å width, at 2280, 2295, 2320, and 2360 Å. With reduction of pressure the bands vanish and the longer wave-length limit of the continuous band moves towards the shorter wave-lengths. At 300° C. the limit of continuous absorption moves 10–20 Å towards the red and the bands are no longer visible. The photochemical decomposition of phosphine, under the action of zinc-aluminium spark radiation, is in accordance with the equation $4PH_3 = P_4 + 6H_2$, the phosphorus being deposited on the walls as a brownish-red film. Molecular hydrogen has practically no influence on the reaction but atomic hydrogen acts as an inhibitor. In a 7-cm. bulb the quantum yield is 0·56, and is independent of temperature up to 300° C. and of pressure variations between 0·04 and 760 mm. The main photochemical oxidation of phosphine in a mixture with oxygen is expressed by the equation $PH_3 + O_2 = H_2 + HPO_2$, the HPO_2 being deposited on the walls. The reaction chains appear to be straight, reaction occurring at every collision of the carrier with a reactant, and to terminate on the walls ; the probability of the chains branching is less than 1 in 200, despite the spontaneous inflammability of the mixtures at higher pressures. The mechanisms of the decomposition and oxidation reactions are discussed [see also Abstract 572 (1933)]. H. F. G.

2363. Photochemical Change of N-Chloroacetanilide in Various Solvents. F. W. Hodges. *Chem. Soc. J. pp.* 240–246, *March*, 1933.—The change, NPhClAc → $NHAcC_6H_4Cl$, under the influence of ultra-violet light ($\lambda = 3659$ Å) has been observed in organic solvents. The rate is very slow in absence of water. It is increased in solvents containing hydrogen, which combines with the atomic chlorine of the solute. The lowest observed rate was in carbon tetrachloride. A. S. C. L.

2364. Photochemistry of Hydrogen Sulphide. N. O. Stein. *Faraday Soc., Trans.* 29. *pp.* 583–591, *April*, 1933.—Visual evidence of the photo-decomposition of gaseous H_2S is afforded by the production of a Tyndall beam, due to the formation of colloidal S particles, when the gas is illuminated in its absorption region. Measurements of the quantum efficiency for monochromatic light of 2050 Å at various pressures show that, for pressures of 250 mm. or less of Hg, the number of H_2 molecules produced for each quantum of energy absorbed is approximately two; with higher pressures, this number increases to 3·8. The completely continuous character of the known absorption spectrum of H_2S indicates, according to spectroscopic theory, that a dissociation of the molecule is the direct consequence of the absorption of light. The three principal ways in which dissociation might take place are: (1) $H_2S = H + H + S$, (2) $H_2S = H_2 + S$, and (3) $H_2S = H + HS$. Complete dissociation into atoms is ruled out, as it requires 174·7 k.cal. From the results of the quantum efficiency measurements, no unambiguous choice between (2) and (3) can be made, and attempts are now being made to identify the products of the primary reaction. T. H. P.

2365. Photochemical Decomposition of Chlorine Monoxide between 2350 and 2750 Å and the Significance of the Absorption Spectrum in this Region. H. J. Schumacher and R. V. Townend. *Zeits. f. phys. Chem.* 20. *Abt. B.* 5–6. *pp.* 375–384, *April*, 1933.—Study of the photo-kinetics of this decomposition gives the quantum yield at 20° C. of 4·5 mol./E. The primary process after light-absorption is dissociation into Cl + Cl + O. The chlorine atoms react further with chlorine monoxide in the manner previously indicated by Finkelnburg, Schumacher and Stieger [see Abstract 2187 (1932)]. Virtually no reaction occurs between the oxygen atoms and the chlorine monoxide (Q more than 11 k.-cal.). Ozone also does not react with the monoxide. T. H. P.

2366. Photochemical Reactions of Monoalkyl Malonic Acids. D. Coster and A. van der Ziel. *Zeits. f. phys. Chem.* 20. *Abt. B.* 5–6. *pp.* 385–397, *April*, 1933.—The irradiation of the *n*-monoalkyl malonic acids produces new substances, but a strongly selective wave-length has not been discovered: sunlight, light from the mercury-silver arc and X-rays all appear to produce similar effects. The new substances have definite Röntgen spectra and are not fatty acids. The influence of diffusion upon the growth of their micro-crystals is established. H. H. Ho.

2367. Photochemical Kinetics of Reactions between Chlorine, Hydrogen and Oxygen. M. Bodenstein and P. W. Schenk. *Zeits. f. phys. Chem.* 20. *Abt. B.* 5–6. *pp.* 420–450, *April*, 1933.—Gaseous mixtures of chlorine, hydrogen and appreciable amounts of oxygen are illuminated, and the yields of water and hydrogen chloride are estimated [see also Abstract 2110 (1931)]. The measurements of water formation give somewhat complicated relationships, the interpretation of which admits of many-sided conclusions. The hydrogen chloride data correspond to the assumption of an atomic chain mechanism. The experiments also indicate that the formation of hydrogen peroxide, sensitised by mercury, is not the chain, $H + O_2 + H_2 = H_2O_2 + H$, but rather, $H + O_2 + H_2 = H_2O + OH$, $2OH + M = H_2O_2 + M$. H. H. Ho.

2368. Germ and Pro-Germ Formation in Relation to the Developable Centres of the Exposed Homogeneous Silver Bromide Grain. L. Hamburger. *Phot. J.* 73. *pp.* 95–105, *March*, 1933.—In earlier work by Reinders and Hamburger [see Abstract **4268** (1932)] it was found that an essential condition for the developability of a silver bromide grain in a normal photographic plate was the presence on the grain surface of at least one germ (nucleus), the minimum critical size of which was at least three atoms of silver. It was also concluded that the sensitivity specks of non-exposed emulsions were either smaller than the germs, or less favourably oriented; these were termed " pro-germs." The consequences of this theory are now discussed and it is shown that the relation between the average number of developable centres per grain on the one hand, and factors such as grain size, exposure, general sensitivity and desensitising, on the other hand, are quantitatively compatible with the suggested very small size of germs and pro-germs. It is also concluded that the data now available are compatible neither with larger critical germ sizes, nor with the assumption of the isolated silver atom being developable. A. H.

2369. Present Position of the Sensitometric Systems. M. Lebelle. *Soc. Franç. Phot. et Ciné, Bull.* 20. *pp.* 39–46, *Feb.*, 1933.—Arranges in tabular form a general survey of the actual position of photographic sensitometry, considering six main sections: criterion of sensitivity, chromatic choice of light source, means of obtaining photographic impression, development, density measurement, methods of defining emulsions. Each section is classified under the three headings, characteristics of the systems or existing methods, advantages, disadvantages, whilst in certain cases the principal bibliographic references are also given. R. C. F.

2370. Criterion of the Speed of Emulsions for Negatives for the Requirements of Modern Practice. F. Lapeyre. *Soc. Franç. Phot. et Ciné., Bull.* 20. *pp.* 49–54, *Feb.*, 1933.—Although it is impossible to classify in absolute terms the emulsion using sensitivity, yet it is necessary to give some method, to the majority of users, of calculating quickly and fairly accurately the necessary exposure time, or for deciding which emulsion to use, and for this purpose the author suggests the term " speed." The speed of a negative emulsion for current practice is defined as a number inversely proportional to the minimum illumination which should be received by the emulsion in the darkest part of the image of a grey subject of contrast 1·5, so that, with an exposure time of 1/20 sec., the negative obtained should give a complete image, passing from white to black, by printing on to a paper of 1·2 gradation, the time of development being varied in consequence. The method of obtaining the above number as well as the development time for a given developer is then briefly described, the assumptions made being clearly stated. Use is made of the characteristic curves of the positive and negative emulsions, and provided the exposure time does not vary by more than 25 % the prints obtained are almost identical. R. C. F.

2371. Absolute Sensitivity of Photographic Layers to Blue and Green Light. M. Biltz. *Phys. Zeits.* 34. *pp.* 200–204, *March* 1, 1933.—Correlates the measurements obtained by previous authors on the

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sensitivity of photographic layers for blue and green light, referring them all to a common unit. The unit chosen is the energy, in ergs per sq.cm. of layer surface, necessary to produce a blackening of 0·1 above that due to fogging action. Owing to the large number of variables in these measurements which cannot be taken into account, the results obtained for a number of different types of panchromatic, orthochromatic and unsensitised Agfa films are given, in which the same absolute unit is used as the basis of comparison, and values are given for monochromatic light of wave-lengths 4360 Å and 5460 Å. The absolute sensitivity of the films for blue light varies between 63 and 3·9 ergs/cm^2. whilst for green light the values lie between 38 and 0·32 ergs/cm^2. For the unsensitised films the ratio of green to blue sensitivity is 0·006 whilst sensitisation increases this ratio by various amounts up to 100 times that of the unsensitised film. R. C. F.

2372. Silver Nucleus Theory of the Latent Image. Part II. Size and Nature of the Nuclei and Pro-Nuclei in Silver Bromide Emulsions. W. Reinders and L. Hamburger. *Zeits. f. wiss. Phot.* 31. 10. *pp.* 265–284, *Feb.*, 1933.—Experiments are described which lead to the following conclusions. (1) Aggregates of silver atoms act as nuclei in physical or chemical development when they reach a certain critical size of three or four atoms. Their efficiency as nuclei increases rapidly with increase of size. (2) Aggregates in which the silver atoms are partially or wholly replaced by other molecules such as AgS, AgSe, etc., can also act as nuclei for liberation of silver. (3) In some sensitive silver bromide-gelatin-emulsion there are grainy pro-nuclei (sensitivity-specks) from which silver is liberated by light. (4) These pro-nuclei are aggregates of a few molecules or atoms consisting of AgS, Ag, and some organic silver or silver sulphide compounds in which the organic part acts as acceptor for the photolytically released bromine. (5) The pro-nuclei become developable nuclei when under light exposure aggregates of Ag or AgS are produced from them. (6) Probability calculations show that in order that a grain of perfect lattice structure may act as a pro-nucleus there must be in it thousands of silver atoms. [For Part I see Abstract 4268 (1932).] J. E.

2373. Diazo-Compounds in Photography. H. D. Murray. *Phot. J.* 73. *pp.* 6–16, *April*, 1933 (*Supplement*).—The author first discusses the diazo-compounds sensitive to light, this section also containing a résumé of the general properties of diazo-products. Photography in single colours by means of diazo-compounds and diazo-type copying papers are next described, and then photography in two or more colours. Two processes are also dealt with which are dependent upon the light sensitivity of silver salts and in which diazo-compounds are used merely for the production of appropriate colours. H. H. Ho.

2374. Light-Sensitive Surface Films. Part III. F. Weigert and E. Eberius. *Kolloid Zeits.* 62. *pp.* 306–310, *March*, 1933.—The results of experiments on Lippmann emulsion [see Abstract 4267 (1932)] can be summarised as follows: The thin surface film becomes sensitive to red light by a definite drying process, and on exposure very small particles are liberated which can be developed. At the same time part of the emulsion cannot be developed and this if irregularly distributed among the particles destroys the mirror and dichroism effects. If, however, a secondary development is applied to this and the emulsion mixed (by re-melting) with red-sensitive particles, a strongly red sensitive emulsion is obtained.

H. M. B.

2375. Testing a Tube Sensitometer. W. S. Armstrong. *Roy. Astron. Soc. Canada, J.* 27. *pp.* 137–145, *April,* 1933.—Because of errors previously encountered in the use of a tube sensitometer an attempt is made to construct an instrument which will be free from such errors. The intensity scale of the sensitometer developed is compared with that given by the inverse square law of intensities and it is found to agree with it with an average deviation of 0·013 magnitudes over a range of 3·0 magnitudes when the steepest portion of the characteristic curve is used to determine the intensities. It is concluded that in the construction of sensitometers of this type it is necessary to ensure that (*a*) provision is made to have uniform illumination of the openings in the tubes, (*b*) the openings in all the diaphragms in the tubes must be accurately centred and aligned, (*c*) internal diaphragms are placed in the tubes so that no internally reflected light can reach the photographic plate. A. H.

See also Abstracts 2277, 2333, 2451, 2510.

PHOTOMETRY.

2376. Photometry and Acuteness of Vision. G. Holst. *Physica,* 13*e.* 2. *pp.* 33–40, 1933.—Two methods have proved particularly appropriate to the comparison of the luminous intensities of sources of light of different colours. These are the method of " blinking " and the method by which adjustment is made step by step to the same luminosity. When comparing white light with a monochromatic light, the method of visual acuteness gives the monochromatic light an intensity some 4 to 5 times as great as the other photometric methods. In lighting technique it is very often the visual acuity which is the more important, so that the luminous intensity obtained by photometric methods is in many cases not a sufficient guide to the value of a given lamp as a source of light. A. D.

2377. Measurement of the Transmission Factors of Coloured Filters used in Heterochromatic Photometry. G. Ribaud. *Comptes Rendus,* 196. *pp.* 687–688, *March* 6, 1933.—The candle-powers of two sources giving radiations corresponding to black-bodies at temperatures T and T^1 can be compared in two ways. The radiation at a given wavelength λ may be measured in each case, and from the ratio of these two monochromatic radiations the ratio of the complete radiations can be calculated. Alternatively it is possible to use a coloured filter in conjunction with one source so as to produce a colour match and thus reduce the problem to one of homochromatic photometry. The transmission factor of the filter may be measured by finding its spectral transmission curve using a spectrophotometer. The author proposes a new method of finding the transmission factor of a filter which converts from colour temperature T to colour temperature T^1. This consists in measuring the ratio of the radiations at a chosen wave-length, λ_0 for two black-bodies operating respectively at temperatures T and T^1. From this measurement the ratio of the total radiations B/B^1 can be calculated. If now, the filter of transmission factor τ be placed in front of the black-body at temperature T, and a rotating sector of transmission t be placed in front of the other black-body, t being chosen so that the two sides of the photometer balance, then $B\tau = B^1 t$, so that τ is found. J. W. T. W.

2378. Heterochromatic Photometry with Tungsten-Filament Lamps. G. Ribaud. *Comptes Rendus,* 196. *pp.* 852–854, *March* 20, 1933.—Consider two lamps operating at the two colour temperatures T and T_0. If ϵ and ϵ_0 be the emissive powers at these two temperatures and N_0 the measured ratio of the candle-powers at wave-length λ_0, then the corresponding ratio N at any other wave-length λ can be calculated from the equation $\lambda \log(N\epsilon_0/\epsilon) = \lambda_0 \log(N_0\epsilon_0/\epsilon)$. The ratio of the candle-powers of the lamps is given by the equation $I/I_0 = \{\int N\lambda^{-5}e^{-n}V_\lambda d\lambda\}/\{\int \lambda^{-5}e^{-n}V_\lambda d\lambda\}$, where V_λ is the visibility factor for radiation of wave-length λ, and n stands for $C_2/\lambda T_0$. It follows that I/I_0 can be calculated from a single spectrophotometric measurement provided the lamps behave closely as black-body radiators. The departure exhibited by tungsten introduces an error of less than 1 part in 2000. The influence of other sources of error is examined in the paper. J. W. T. W.

See also Abstracts 2346, 2375.

POLARISATION.

2379. Rotatory Power and Mutarotation of Aluminium Emetic. Pariselle. *Comptes Rendus*, 196. *pp*. 918–920, *March* 27, 1933.—Pure aluminium emetic, prepared as a glassy, uncrystallisable solid, is lævorotatory in concentrated solution and strongly dextro-rotatory in dilute solution. The addition of sufficient water to a strong solution to bring the molecular concentration to 0·5 gives rise to mutarotation, over a period of an hour, the curve being exponential in form, and the final dispersion ratio $a_{4358}/a_{5461} = 2$. The rotatory power of the final solution varies almost linearly with temperature up to 35°, the value of the dispersion ratio also changing. It is concluded that two forms of molecule are present, and that one molecule of the lævo-rotatory gives rise to two of the dextro form, probably by hydrolysis. Attempts to determine the molecular weight of the dextro-rotatory form cryometrically suggest that it contains two atoms of aluminium. C. B. A.

2380. Rotatory Power of Salts of Quinine in Aqueous Solution. C. Lapp. *Comptes Rendus*, 196. *pp*. 970–971, *March* 27, 1933—On account of dissociation the rotatory power of an aqueous solution of a quinine salt is the sum of the effects due to all the active particles present. Its variation with pH is studied for four visible wave-lengths, and at concentrations below 1 % of pure quinine. The curves relating the two quantities show points of inflection at each pH value corresponding to a dissociation of the active molecule. $[a]$ is found to remain constant over a range of pH from 4·6 to 6·5, corresponding to an equilibrium between dissociated and undissociated molecules. In strongly acid solutions the beginning of anomalous rotation can also be detected. The significance of these results in chemical analysis is discussed. C. B. A.

2381. Drude Theory of Optical Activity. W. Kuhn. *Zeits. f. phys. Chem.* 20 *Abt.B.* 5–6. *pp*. 325–332, *April*, 1933.—It is claimed that the Drude model for optical rotatory power is not valid in that, whilst the expression deduced from it fits the experimental data, these results are only obtained when the $(\partial E_x/\partial z)$ term is omitted in considering the force exerted on the model by the field of the light wave. The author also claims that no such point has been overlooked in the treatment of his own model for rotatory power. C. B. A.

See also Abstracts 2103, 2349, 2356.

RADIATION, EMISSION.

2382. Photographs of the Tracks of Penetrating Radiation. P. M. S. Blackett and G. P. S. Occhialini. *Roy Soc., Proc.* 139. *pp*. 699–726, *March* 3, 1933.—A method of making particles of high energy take their own cloud photographs is described, and the most striking features of about 500 photographs so taken are considered. Observations of the range, ionisation, curvature and direction of the particles confirm Anderson's view that particles must exist with a positive charge but with a mass comparable with that of an electron. The frequency of occurrence of the showers of particles producing the complex tracks and their nature are discussed, and also their possible relation to the bursts of ionisation noticed by various observers. It is considered that the positive and negative electrons are created during a collision process. Various hypothetical properties of the positive electrons are discussed in the light of Dirac's theory of "holes." [See Abstract 2338 (1933).] J. J. S.

2383. Acquirement of Cosmic-Ray Energies by Electrons. W. F. G. Swann. *Frank. Inst., J.* 215. *pp.* 273–279, *March*, 1933.—It is usually considered that the assumption of the existence of electronic energies of the order 10^{10} volts is attended with considerable theoretical difficulties. In this paper calculations are given as to the possibility of the production of cosmic-ray energies in stellar spots analogous to sunspots on our sun. Sunspots possess considerable magnetic fields which grow in comparatively short periods of time. Calculation shows that it would be difficult to secure energies of 10^{10} volts from spots of a size such as occur on the sun, but that energies one-tenth of this amount are within the range of possibility. With magnetic fields extending over large areas in stellar spots relatively small rates of change of these fields existing for brief periods can give rise to large electronic energies. The efficiency of the process of accumulation of energy is probably but little reduced by collisions. [See Abstract 579 (1933).] J. J. S.

2384. Angular Distributions of Cosmic Radiation at Elevations of 6280 ft. and 620 ft. T. H. Johnson. *Phys. Rev.* 43. *pp.* 307–310, *March* 1, 1933.—The ray intensity $j(\theta)$ of the cosmic radiation has been studied as a function of the angle θ from the vertical on Mt. Washington, New Hampshire, elevation 6280 ft. and at a base station, elevation 620 ft. The results show a distribution less concentrated about the vertical at the higher elevation. Unless some *ad hoc* assumption is invoked this result is inconsistent with the intensities and absorption coefficients deduced by Millikan and Cameron [see Abstract 2718 (1931)] as their results would lead to a considerably more concentrated distribution at the upper elevation. Integrating the ray intensities over all angles, the total numbers of rays per cm^2 per sec. have been computed at the two elevations. The increase in the number of rays with elevation is less than the known increase in the ionisation (Millikan and Cameron). The ratio of numbers of rays per sec. is 1·46 against 1·91 for the ratio of ionisations at the two elevations. The average 6280-ft. ray, therefore, produces 1·31 as many ions per unit path as the 620-ft. ray. This change in ionising efficiency may perhaps be explained by supposing that the softer rays, which are more predominant at the upper level, produce more secondary rays from the walls of the ionisation vessel. AUTHOR.

2385. Geographic Study of Cosmic Rays. A. H. Compton. *Phys. Rev.* 43. *pp.* 387–403, *March* 15, 1933.—A further report is given of data obtained from measurements of the intensity of cosmic rays by 8 different expeditions at 69 stations distributed at representative points over the earth's surface. Each set of apparatus consisted of a 10-cm. spherical steel ionisation chamber filled with argon at 30 atmospheres, connected to a Lindemann electrometer and shielded with $2\cdot5$ cm. of bronze plus $5\cdot0$ cm. of lead. Measurements were made by comparing the ionisation current due to the cosmic rays with that due to a standard capsule of radium. Methods of detecting and correcting for various disturbing effects are discussed. Intensity-altitude curves are given for various latitudes. These show not only rapid increase with altitude, but also greater intensity at each altitude for high latitudes than for those near the equator. The variation observed follows the geomagnetic latitude (*i.e.*, the latitude relative to the pole of the earth's uniform magnetisation) more closely than the geographic or the local magnetic latitude. If the cosmic rays are electrons, considering deflection by the earth's magnetic field they must originate not less than several hundred kilometres above the earth. The data can be quantitatively explained on the basis of Lemaître and Vallarta's theory of electrons approaching the earth from remote space. J. J. S.

2386. New Observatory of Cosmic Rays. L. Tuwim. *Comptes Rendus,* 196. *pp.* 950–952, *March* 27, 1933.—Details are given of an observatory of cosmic rays in which the action of obstacles in the path of the rays and errors through local radioactivity are avoided. The observatory is installed at the laboratory of physical chemistry of the Faculty of Sciences of Paris at the top of an astronomical tower and has a screen of inactive lead 10 cm. thick not overtopped by neighbouring houses. Observations made to test if rays traversing the counting tube were not recorded gave the result that the rays not counted are negligible. Observations were taken at low pressures, $0\cdot5$ mm. and $0\cdot1$ mm. (air), and from these it appears that for the counter at low pressure the number of cosmic impulsions is equal to the number of pairs of ions in an ionisation chamber of the same dimensions at the same pressure. This result may be explained by two hypotheses: (1) the action of the counting tube occurs for a single pair of ions; and (2) the cosmic rays produce, in most cases, a single pair of ions in the counting tube at small pressure. J. J. S.

2387. Interpretation of the Experimental Values for the Average Specific Ionisation of Cosmic Radiation from Measurements with the Ionisation Chamber and with the Tube Counter. W. Kolhörster and L. Tuwim. *Zeits. f. Physik,* 81. 7–8. *pp.* 435–439, *March* 30, 1933.—The experimentally determined value of $k = 135$ ions per cm., although anomalously high on classical theory, is in agreement with recent results based on quantum mechanics. The conception of specific ionisation is defined [see Abstract 1323 (1932)] and the quantity determined experimentally corresponds to this if (1) a straight-line relation exists between the number of collisions and the square of the sine of the angle of inclination of the axis of the counter to the vertical, and (2) N_0 is independent of the dimension of the counter. The fact that the cloud track method gives a lower value for the specific ionisation is shown not to be a legitimate argument against the validity of the higher values.

F. C. C.

2388. Spectrum and Latitude Variation of Penetrating Radiation. E. J. Williams. *Nature,* 131. *pp.* 511–512, *April* 8, 1933.—An account is given of some calculations on the spectrum and latitude variation of penetrating radiation on the assumption that it consists of electrons coming to the earth from outside. If it is assumed that the electrons are incident on the atmosphere uniformly in all directions it may be shown that the number of incident electrons with a range R is proportional to the value of xd^2I/dx^2 at a depth $x = R$. I denotes the intensity of ionisation at a depth x, the latter and the range R being measured in terms of distances travelled in a homogeneous medium. From this relation and also the relation between range and energy, the energy spectrum of the incident electrons can be deduced directly from the ionisation-depth variation. Curves are given showing the variation of sea-level ionisation with latitude. J. J. S.

See also Abstract 2340.

RADIATION, GENERAL THEORY.

See Abstract 2218.

RADIATION, MECHANICAL EFFECTS.

2389. Radiometer Action and Pressure of Radiation. Mary Bell and S. E. Green. *Phys. Soc., Proc.* 45. *pp.* 320–355; *Disc.*, 355–357, *March* 1, 1933.—The paper falls into two parts, in the first of which radiometer action is investigated. This has disappeared at a pressure of about 10^{-6} cm. of mercury. The second part deals with the pressure of radiation. It is pointed out that the claim of Nichols and Hull to have obtained agreement between pressure and energy density to 1 % is incorrect, the true figure being about 10 %. The authors have now obtained 3 to 4 % agreement, which is rather better than in the recent work of Miss Golsen. J. H. A.

REFLECTION. REFRACTION AND DISPERSION.

2390. Testing of Reflectors. S. Wachowski. *Acta Physica Polonica*, 2. 1. *pp.* 75–80, 1933. *In French.*—Two tests are discussed, one consisting essentially of photographing the image of a square pattern and the other of measuring the image position of a collimated object, when the light is directed to various portions of the mirror surface. The apparatus used in the tests is described and the results from the two methods are compared for three types of mirror. W. D. W.

2391. Error of Direction Produced by a Glass Mirror. V. Thelmer. *Zeits. f. Instrumentenk.* 53. *pp.* 122–128, *March,* 1933.—When using a mirror it is assumed that a single image of the source is obtained on the normal from the object to the mirror and at a distance $(D + \Delta)$, where D is the distance from the object to the front of the mirror and Δ the thickness of the mirror. An equation is first obtained for the reflected ray with different angles of incidence and it is found that the geometrical location of an image of a luminous point (L) is that surface of rotation which arises if the curve given by a determined equation rotates around the normal to the mirror from the point L. This result is used to obtain the error of direction arising in observations with mirrors. The error is zero only for an image at infinity, for perpendicular incidence, or if the glass has a refractive index equal to that for air. A numerical example is given for a reflecting declinometer. R. S. R.

2392. " Aberrations of Coma " in Beams of Large Inclination. F. Croze. *Comptes Rendus,* 196. *pp.* 913–916, *March* 27, 1933.—A method is given for the determination of the " aberrations of coma " in a beam falling at finite incidence on a dioptre of finite aperture in the particular case when the plane of incidence of the central ray is a plane of symmetry for the beam and for the dioptre. C. B. A.

2393. Refractive Indices of Ammonium Nitrate. S. B. Hendricks, W. E. Deming and M. E. Jefferson. *Zeits. f. Krist.* 85. 1–2. *pp.* 143–155, *March,* 1933. *In English.*—The method of W. L. Bragg for calculating indices of refraction is applied in a modified form to the various modifications of ammonium nitrate. The means of the refractive indices for each of the four birefringent forms are approximately the same when reduced to the equal densities. The calculated values of the maximum indices of refraction for these forms agree with those obtained experimentally. The angles between the planes of the nitrate groups in the tetragonal and orthorhombic forms are calculated from the refractive indices and optic orientations. The results agree with those obtained from X-ray data. The structure of a fifth modification has not been determined but powder photographs indicate that it is hexagonal. The refractive indices are such as to suggest that the planes of the nitrate groups are parallel to the presumed hexagonal axis. J. T.

2394. Refractive Indices of Liquid Mixtures with Pyridine as Component. N. A. Puschin and P. G. Matavulj. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 80–86, *March,* 1933.—The refractive indices of mixtures of various proportions of pyridine with eight different phenols are recorded. In each case, the curve of Δ_n against c (Δ_n = difference between observed and calculated indices : c = concentration) shows that compounds of the two components exist with the same composition in the liquid as in the crystalline form. Similar evidence is obtained in three cases from the variation of temperature coefficient (dn/dt) with concentration. C. B. A.

2395. Refractivity of Para-Hydrogen. C. and Maude Cuthbertson. *Roy. Soc., Proc.* 139. *pp.* 517–520, *March* 3, 1933.—Para-hydrogen was prepared by adsorption of pure hydrogen in charcoal at the temperature of liquid oxygen and the refractive index of a mixture of about 47 % para to 53 % ortho was measured. It was found that at the temperature of the room for the green mercury line the index does not differ from that of ordinary hydrogen. The limits of error of the experiments were about 3 parts in 14,000. AUTHORS.

2396. Measurement of Gradual Variations of Refractive Index. A. Biot. *Ann. Soc. Sci. de Bruxelles,* 53. *pp.* 5–11, *March* 13, 1933.—The problem of measuring slow changes in refractive index in a glass plate is complicated by the necessity to separate out the effects of index variation from similar effects produced by slight variations in the thickness of the plate. The problem can be solved satisfactorily by the use of an interferometer, but a less costly method is described which depends on measurements of the interference fringes produced between two thick plates. W. D. W.

2397. Simple Method of Determining the Refractive Index of a Liquid. S. C. Gladden. *Rev. Sci. Instruments,* 4. *pp.* 231–232, *April,* 1933.—A simple method of measuring the refractive indices of transparent liquids is described, in which a watch-glass serves to give the liquid the form of a plano-convex lens. The image of the maker's trademark on an incandescent lamp is focussed by means of the liquid lens on a movable screen. The screen is supported on an optical bench mounted vertically. By using the image equation, $1/a + 1/b = (n - 1)(1/R)$, the refractive index, n, may be determined. A Wallace type G colour filter is employed to give results comparable with the values of n determined with Na light.

Results are given for distilled water, toluene, benzene and carbon tetrachloride. The greatest source of error lies in the vibration of liquids of low viscosity, which introduces difficulties in focussing. AUTHOR.

2398. Molecular Refraction in Dilute Solutions. Part I. Differential-Buoyancy Method for Accurate Density Measurements. W. Geffcken, C. Beckmann and A. Kruis. *Zeits. f. phys. Chem.* 20. *Abt.B.* 5–6. *pp.* 398–419, *April,* 1933.—An improvement of Lamb and Lee's suspension method [see Abstract 373 (1914)] has enabled the density of a solution relative to the solvent to be measured up to concentrations of 1·5 *N*. The absolute accuracy attained increases from about $0 \cdot 0_5 2$ for the most concentrated solutions to about $0 \cdot 0_6 2$ for solutions below 0·1 *N*. The influence of errors upon the results is discussed, and is illustrated by two series of measurements with solutions of sodium chloride and sodium carbonate. H. H. Ho.

2399. Dispersion of Optical Glasses. A. Biot. *Ann. Soc. Sci. de Bruxelles,* 53. *pp.* 11–13, *March* 13, 1933.—It is desirable to represent the dispersion of optical glasses by a formula that is independent of the particular source of light used to measure the indices. The note indicates how this may be done by the use of an auxiliary formula to express the experimental data in terms of an agreed set of wave-lengths, with particular reference to a dispersion formula recently proposed by the author [see Abstract 1974 (1933)]. W. D. W.

2400. Spectro-Chemistry of Pyridine- and Prydone Derivatives. K. v. Auwers. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 33–43, *March,* 1933.—The refraction and dispersion of halogen and alkyl substitution products of pyridine are determined and compared with the corresponding values in the case of substitution products of benzene. Like the alkyls, the halogens diminish the specific depression of pyridine, iodine producing the most marked effect. The groups $-\mathrm{CO_2R}$, $-\mathrm{CO.R}$ and $-\mathrm{CHO}$ effect exaltation through the production of active conjugation as in the benzene series, their effect increasing in the order given. In the case of the benzene series, the specific exaltation is depressed by the introduction of chlorine into the nucleus ; the same occurs in the case of the corresponding pyridine compounds. The definite spectro-chemical differentiation of oxy-pyridines and pyridones is not always possible [see following Abstract]. J. S. G. T.

2401. Significance of the Specific Exaltation of Molar Refraction and Molar Dispersion. K. v. Auwers. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 44–47, *March,* 1933.—By specific exaltation, a term introduced by Hückel, is to be understood the excess of the experimental value of the specific refractive index of a substance over the theoretical value. For compounds of similar structure the specific exaltation is, within limits, the same, and its value can be used to determine structural characteristics of the substance, *e.g.,* changes of conjugation, the existence of ring structures, etc. The exaltation of molecular refraction is determined partly by the effect of the occurrence of definite groups and partly by molecular dimensions. It can therefore be applied to the investigation of problems of constitution only within a very restricted region. J. S. G. T.

2402. New Measuring Eyepiece. H. Wedemeyer. *Zeits. f. Instrumentenk.* 53. *pp.* 159–164, *April,* 1933.—A device is described for use as a substitute for the micrometer eyepiece used for example, in microscopes for reading the divided circle of a spectrometer. In the plane of the image of the circle a fine pointer can be rotated and used to indicate the position of the fiducial mark between neighbouring scale divisions. The rotating pointer serves to magnify the scale division on a lever principle, and the reading is given on a circular scale at the edge of the field. Tests are described that show that a high precision of setting can be obtained and an advantage over the ordinary micrometer eyepiece is claimed, owing to the absence of any screw motion. W. D. W.

See also Abstracts 2103, 2122, 2143, 2242, 2248, 2299, 2359, 2422, 2438, 2452.

SPECTROSCOPY.

2403. Arc Spectrum of Radium Emanation. E. Rasmussen. *Zeits. f. Physik*, 80. 11–12. *pp.* 726–734, *Feb.* 23, 1933.—Gives a table of about 200 lines in the visible and infra-red arc spectrum of radium emanation obtained by mixing it with helium, argon and neon. The author was able to postpone occlusion of the gas by using electrolytic iron for the kathodes. The plates were developed by means of mesocyanin and xenocyanin. E. E. F. d'A.

2404. Spectrum of Rhenium. H. Schober. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 9–10. *pp.* 601–616, 1932.—In continuation of previous work [see Abstract 3066 (1931)], the arc spectrum from 5400 Å–4000 Å, excited on copper electrodes, has been investigated. Over 700 lines are listed. F. S.

2405. Effect of Temperature on the Mercury Spectrum. O. Masaki. *Hiroshima Journ. Sci.* 3. *pp.* 61–65, *Dec.*, 1932. *In German.*—A quartz mercury discharge tube mounted in an oven is described. It is found that the intensities of certain lines decrease as the temperature is raised to 160° C. and then increase again. The resonance line behaves in the opposite manner. All known bands appear at temperatures exceeding 160° C. F. S.

2406. Intensity Relations of the D-Lines in a Sodium-Gas Discharge. W. de Groot. *Physica*, 13*e*. 2. *pp.* 41–50, 1933. *In German.* —The ratio of intensities of the D-lines from a self-heating low-voltage sodium lamp was found as a function of power input for different gases (Ne, A) and gas pressures (0·2–4 mm.). A theoretical discussion precedes the record of observations. The increase of the ratio D_2/D_1 at high gas-pressure is attributed to the influence of radiation-broadening on absorption. F. S.

2407. Distribution of Emission in Arcs. K. Brückersteinkuhl. *Zeits. f. wiss. Phot.* 32. 1–2. *pp.* 3–62, *March*, 1933.—The spectra of various arcs were examined with a small concave grating and a quartz spectrograph. It is found that most spectra are stronger at the poles, and that the lines can be arranged in groups according as to which pole gives the stronger lines or if they are equal. Lines of the arc and spark spectra are each divided into 3 classes in this way. The arc classes are compared with King's temperature classes, and this allows the fixing of steps of excitation. Results are given for a number of elements. F. S.

2408. Spectra of the Ca I-Like Ions : Mn VI, Fe VII, Co VIII and Ni IX. W. M. Cady. *Phys. Rev.* 43. *pp.* 322–328, *March* 1, 1933.—The spectra of four new ions have been added to the sequence of spectra isoelectronic with Ca I. A vacuum spark produced the radiation, which was analysed in a vacuum spectrograph with a concave grating set for grazing incidence. The transitions observed were those between the ground configuration, $3d^2$, and the lowest configuration that combines with it, $3d\ 4p$. Nearly all the levels to be expected in these configurations were found, for all four spectra. Almost all the allowed transitions among the observed levels were identified, as were several intercombinations and other forbidden lines. Slater's theory for the levels (neglecting fine-structure) in a configuration gives a good fit with the observed multiplets, especially in $3d\ 4p$, which is remote from other odd configurations. In $3d^2$, $^1D_2$ is evidently perturbed by $3d\ 4s$. AUTHOR.

2409. Investigation of Natural Gases for Helium Content. E. v. Angerer and H. Funk. *Zeits. f. phys. Chem.* 20. *Abt.B.* 5–6. *pp.* 368–374, *April*, 1933.—A simple spectroscopic method for testing gases for helium is described. The concentration of the helium is effected by means of active carbon and the stimulation to luminescence by electron shock. The results of the investigation of twelve samples of natural Bavarian gases are given. T. H. P.

2410. Effect of Foreign Gases on the Relative Intensities of the Hg Triplet 2^3P_{012}–2^3S_1 under Conditions of Optical Excitation. R. T. Macdonald and G. K. Rollefson. *Phys. Rev.* 43. *pp.* 177–180, *Feb.* 1, 1933.—By stepwise excitation unexcited Hg atoms are raised to the 2^3S_1 state. They may leave this level by four paths, one of low probability to 2^1P_1 and the other three to 2^3P_2, 2^3P_1 and 2^3P_0, with emission of 5461, 4358 and 4046 Å. Measurements by independent methods of the mean life of the 2^3S_1 state yielded, when measured by the line 5461 Å, approximately 4 times that given by 4358 or 4046 Å. The addition of foreign gas should decrease this ratio while keeping the ratio given by 4358 and 4046 Å constant. All the ratios were found in fact to be independent of the pressure up to 400 mm. in the case of N_2 and up to 100 mm. with N_2–CO_2 mixtures. J. E.

2411. True and Apparent Distribution of Intensity in Spectral Lines. Part II. H. C. Burger and P. H. van Cittert. *Zeits. f. Physik*, 81. 7–8. *pp.* 428–434, *March* 30, 1933.—The convergence of the solution of the integral equation discussed in a previous paper [see Abstract 1040 (1933)] is considered. J. S. G. T.

2412. Line Groups and Fine Structure. F. Paschen. *Preuss. Akad. Wiss. Berlin, Ber.* 32. *pp.* 502–513, 1932.—If the hyperfine structure of a group of lines is equal to or greater than the gross structure, the magnetic moment of the nucleus acts similarly to an external magnetic field. Corresponding to the Paschen-Back effect of an external field there occurs a special perturbation effect of the gross structure which results in a simplification of the hyperfine structure. Cases of this nature appear in the spectrum of Al II, for the nucleus of the aluminium atom has a moment of $1/2.h/2\pi$ which, in the spectra Al I and Al II gives rise to a hyperfine structure of the same order of magnitude as the ordinary gross structure. Certain triplet groups of Al II present an analogy to a complete magnetic transformation of gross structure components. Further, in analogy to the earlier stages of magnetic transformation, there occur in the corresponding hyperfine structure effect displacements and intensity changes of the components and forbidden components appear. These effects are illustrated by examples from the spectra of Al II and Hg I. J. E. K.

2413. Nuclear Moments of Tellurium and Selenium Isotopes. S. Rafalowski. *Acta Physica Polonica*, 2. 1. *pp.* 119–123, 1933. *In German.* —Five lines of the arc spectrum of Te and two lines of the arc spectrum of

Se, lying in the region λ 3000 Å to λ 2000 Å, are investigated for the presence of hyperfine structure with the aid of a quartz Lummer-Gehrcke plate 6·9 mm. thick and 20 cm. long in conjunction with a Hilger quartz spectrograph. All the lines were found to be of single structure. It is concluded that the even isotopes of Se and Te have no nuclear moments and exhibit no electrical line-displacements. J. E. K.

2414. Hyperfine Structure of the Lines of the Arc Spectrum of Rubidium. D. A. Jackson. *Roy. Soc., Proc.* 139. *pp.* 673–682, *March* 3, 1933.—The hyperfine structure of the lines 7947, 7800, 4215 and 4201 Å of the arc spectrum of rubidium was investigated with a reflection echelon grating of high resolving power. The spectra were excited by a h.f. discharge in a tube containing a helium-neon mixture at ½-mm. pressure and a small quantity of rubidium. The four lines each possess four components, in λλ 4215 and 4201 two of the components appear as one broadened unresolved component. The structure is caused by a splitting into two of the $5^2S_{\frac{1}{2}}$ level, the two weak components belong to the isotope Rb 87 and the two stronger components belong to the isotope Rb 85. The centre of gravity of the levels of Rb 85 is displaced with respect to that of the levels of Rb 87. Intensity measurements of the components of λ4201 show that the nuclear moment of Rb 85 is $I={}^3/_2$ and give a probable value of $I={}^5/_2$ for the nuclear moment of Rb 87. The magnetic moment of the nucleus of Rb 87 is about two and a half times as great as that of Rb 85. J. E. K.

2415. Transformations in the Theory of Complex Spectra. G. H. Shortley. *Phys. Rev.* 43. *pp.* 451–458, *March* 15, 1933.—Four transformations are considered in detail: that from the zero-order nlm_lm_s scheme to the *LS*-coupling scheme, that from the zero-order $nljm_j$ scheme to the *jj*-coupling scheme, that connecting these two zero-order schemes, and that connecting the *LS*- and the *jj*-coupling schemes. A correlation between the states of the configuration with ϵ electrons in shell *S* plus η other electrons and those of the configuration with ϵ electrons missing from shell *S* plus the same η other electrons is found such that all of these transformations are the same for the two configurations. The transformation between zero-order states in two different schemes is considered in general and a general expression (3·10) is found giving this transformation for an almost closed shell in terms of the transformation for corresponding simple configuration. Finally, a direct method is found for obtaining the transformation from *LS*-coupling to *jj*-coupling for any two-electron configuration, and this transformation is given explicitly for all such configurations up to *dd*. This then furnishes the *LS-jj*-coupling transformation also for p^4, p^5s, p^5p, p^5d, d^8, d^9s, d^9p, and d^9d, the configurations for which the *jj*-coupling scheme is most useful. AUTHOR.

2416. Wave Functions for the Ground State of Lithium and Three-Electron Ions. E. B. Wilson, Jr. *J. Chem. Phys.* 1. *pp.* 210–218, *March*, 1933.—Improved wave functions and ionisation potentials have been obtained for the configuration $1s^2\ 2s$, by using the variation method with a variation function containing four parameters. The wave function for the whole atom is of the determinant form, built up of *K* and *L* single-electron functions. The *K* function used is hydrogen-like with one parameter, the effective nuclear charge, and the *L* function is of the form $are^{-\eta r}-e^{-\zeta r}$. A simple rule is obtained by means of which it is possible to write down the wave function for any three-electron ion without further calculation. The deviation of the calculated ionisation potentials from the observed values is 0·9% for Li I and decreases to 0·3% for C IV. Comparison is made with the results of other investigators and curves showing the wave functions and electron density functions are given. AUTHOR.

2417. Effects of Pressure on the Visible Band Spectra of Nitrogen. H. S. Harned and E. R. Brownscombe. *J. Chem. Phys.* 1. *pp.* 183–185, *March*, 1933.—The visible band spectrum of nitrogen produced by an electrodeless discharge has been studied at pressure ranging from 0·002 to 4 mm. At the lowest pressures the spectrum was almost entirely composed of the first negative bands due to N_2^+. The first positive bands appeared very faintly. As the pressure of the discharge was increased, the first and second positive band systems greatly increased in intensity, up to a pressure of 0·2 mm. At still higher pressures the second positive bands were found to fade until at pressures of 4 mm. they were just noticeable. In the case of the first negative bands, it is found that increase of pressure increases the number of N_2^+ ions in the higher rotational states. AUTHORS.

2418. Selection Rules for the Vibration Spectrum of Calcite. F. Matossi. *Phys. Zeits.* 34. *pp.* 230–232, *March* 15, 1933.—A discussion and criticism of the selection rules of Dennison [see Abstract 3062 (1931)]. W. R. A.

2419. Infra-Red Absorption Bands of Methane. W. V. Norris and H. J. Unger. *Phys. Rev.* 43. *pp.* 468–472, *March* 15, 1933.—The fine structure of the infra-red bands of methane in the region 1–2μ has been observed, and four new bands located at 1·135, 1·187, 1·330 and 1·734μ. The 1·66μ band observed by Moorhead was re-observed with the result that some 14 new lines were added to it. The line spacing in all the bands in this region is of the order of 10·5 cm^{-1}, but varies from 9·44 to 10·8 cm^{-1}. All the bands have sharp zero branches with a tendency to shade off on the low-frequency side, except for the one at 1·33μ, which is quite symmetrical in all its branches. The positive branch of the 1·66μ band decidedly converges to the red (line spacing increases towards the high frequencies), which was also observed by Cooley in the 3·5μ band. The infra-red data in the region observed favours the tetrahedral model assumed by Dennison for theoretical work. It is possible to use as a fundamental frequency $\nu_1=2913$ cm^{-1}, found in the Raman spectrum, in representing the harmonic and combination bands of methane instead of the usually assumed 4217 cm^{-1} ($=\nu_1+\nu_4$). [See also Abstract 1502 (1933).] AUTHORS.

2420. Band Spectrum of Water-Vapour. Parts I, II and III. R. Mecke, W. Baumann and K. Freudenberg. *Zeits. f. Physik,* 81. 5–6. *pp.* 313–331, *March* 22; *and* 81. 7–8. *pp.* 445–481, *March* 30, 1933. —A very detailed study is given of the seventeen bands in the spectrum of water-vapour whose wave-lengths lie between 10,000 and 1000 Å. The theory of the production of these bands is gone into and the various properties of the molecules which can be deduced from the spectrum are given. An analysis of those lines of the solar spectrum which can be ascribed to atmospheric sources reveals that one-third of the lines with wave-lengths between 10000 and 5000 Å belong to the ten bands of the spectrum of water-vapour which lie in that region. G. C. McV.

2421. Equivalent Widths in the A and B Bands of Oxygen. W. H. J. Childs. *Astrophys. J.* 77. *pp.* 212–220, *April*, 1933.—The previous conclusion of Woolley [see Abstract 2616 (1931)], that the width of an absorption line is proportional to the 3/8 power of the number of molecules and not to the square root of the number of absorbing centres, is not borne out by measurements of the equivalent widths of the lines of the A and B bands of oxygen. The value obtained for the power from the work described is 0·49. It is also shown that the equivalent widths of these atmospheric lines are in excellent agreement with the widths calculated from observations on laboratory thicknesses of air (13·7 m.). A. H.

2422. Absorption of Cobaltous Compounds. Part IV. Alkali Oxide Boric Oxide Glasses. W. R. Brode. *Am. Chem. Soc., J.* 55. *pp.* 939–947, *March*, 1933.—The position of the absorption band is unaltered by change of alkali oxide. Changing to alkali sulphide or halide gives a shift of the bands to those characteristic of these complexes and whose position depends on the atomic weight of the substituted element. The cobalt oxide blue glasses therefore belong to the same system of coordinated cobalt blue compounds as the halogen acid colours, the halogen salt colours in the presence of calcium chloride, etc. In all of these the coordinating element is apparently part of the chromophore, the other elements attached having little influence. The pink glasses containing a high concentration of boric oxide have the same absorption band as the aqueous solutions of cobaltous salts, which is ascribed to the uncoordinated cobaltous atom. J. E.

2423. Broadening of the Ultra-Violet Absorption Bands of Xenon under Pressure. J. C. McLennan and R. Turnbull. *Roy. Soc., Proc.* 139. *pp.* 683–698, *March* 3, 1933.—Earlier work has shown [see Abstract 836 (1931)] that with increasing pressure xenon exhibits an unusually large broadening of the resonance line (λ1469). In the present work the results of a further study of this pressure effect are given ; the asymmetrical development of the band on the long-wave side is a noteworthy feature. The results are discussed, and it is concluded that the absorption exhibited is primarily that taking place during collisions when the atomic energy levels are perturbed by mutual interactions. Two-body collisions are mainly responsible at low pressures, whilst above 90 mm. pressure it is believed that collisions between three or more atoms occur frequently enough to affect the absorption. A study is also made of the effect of temperature variation upon the absorption, a constant mass of gas being maintained in the absorption cell. The main effect observed here is that with decreasing temperatures the short wave limit of the band shows a distinct shift towards shorter wave-lengths. It is considered significant that this latter effect is observed only when temperatures approaching that of liquefaction of the gas are employed. It is suggested that this indicates the formation of aggregates. The band absorption about the shorter resonance line (λ1295) is also investigated. Here also with increasing pressure the greater shift is to the long-wave side, but the effect is not as marked as with λ1469. A. H.

2424. New Band in Spectrum of OH Molecule. H. L. Johnston, D. H. Dawson and Margery K. Walker. *Phys. Rev.* 43. *pp.* 473–480, *March* 15, 1933.—Although the ultra-violet " water vapour " bands were among the earliest molecular spectra to undergo extensive investigation, heretofore only six bands have been reported. These involve transitions between the (0, 1, 2) vibrational levels of an excited $^2\Sigma$ state and the (0, 1) vibrational levels of the normal $^2\Pi$ state. With improved conditions for exciting the spectrum we have obtained 91 lines, heretofore unreported, in the neighbourhood of the (0′, 1″) band at λ3428. 44 of these lines prove to be extensions of λ3428; 54 lines (including 11 in common with λ3428) form a new band with a head at λ3484; and 4 lines remain unidentified. Analysis of the new band identifies it as the (1′, 2″) band of the water vapour system. Rotational constants for the normal $^2\Pi$ electronic state of OH are: $B_e'' = 19{\cdot}025, \alpha'' = 0{\cdot}724, D_e'' = -1{\cdot}97 \times 10^{-3}, \beta'' = 5{\cdot}0 \times 10^{-5}$, and $r_e'' = 0{\cdot}964 \times 10^{-8}$ cm. Vibrational constants are: $\omega_e'' = 3734{\cdot}9$ and $x_e''\omega_e'' = 82{\cdot}6$. Rotational and vibrational constants for the excited $^2\Sigma$ state are also evaluated and are tabulated. AUTHORS.

2425. Absorption of Substituted Benzols. Parts II and III. Xylidines and Xylenols. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 20. *Abt.B.* 3–4. *pp.* 222–236, *March*, 1933.—The ultra-violet absorption spectra of xylidines and xylenols are recorded and discussed with reference to the intensities of the bands. A calculating rule is given which permits a determination of the displacement of the ultra-violet bands of benzol caused by substitution. J. E. K.

2426. Absorption of Carbon Compounds in the Schumann Region. G. Scheibe, F. Povenz and C. F. Linström. *Zeits, f. phys. Chem.* 20. *Abt.B.* 3–4. *pp.* 283–304, *March*, 1933.—The absorption of methyl iodide, ethyl iodide, tertiary butyl iodide, acetaldehyde, acetone, a number of acids and esters and benzol was investigated as far as 1500 Å using a quartz and a fluorite spectrograph with hydrogen discharge as source. Parallel C-H and C-I vibrations and also perpendicular vibrations were found for the first two substances. Parallel C-H vibrations were also found for acetone and acetaldehyde. A band with fine structure was found in the case of methyl iodide. F. S.

2427. Optical Investigations of Perylene and its Derivatives. Part IV. Ultra-Violet Absorption Spectrum of 1 : 12-Derivatives and of Isomerides. Cheng Huachih and H. Conrad-Billroth. *Zeits. f. phys. Chem.* 20. *Abt.B.* 5–6. *pp.* 333–339, *April*, 1933.—As with all perylene compounds, the spectra of 1 : 12-perylene derivatives show two groups of bands, one at the limit of the visible spectrum and the other at about 39,000 cm.$^{-1}$. 1 : 12-Perylene peroxide shows entirely different absorption from 1 : 12-perylenequinone and is hence not structurally similar to the latter. The bearings of the results on the structures of these and other perylene derivatives are discussed. [For Part III see Abstract 1959 (1932).] T. H. P.

2428. Absorption of the Halogen Derivatives of Methane in the Near Ultra-Violet and their Dissociation Energies. T. Iredale. *Zeits. f. phys. Chem.* 20. *Abt.B.* 5–6. *pp.* 340–344, *April*, 1933.—The absorption spectra of methyl iodide, methylene iodide, and iodoform, and methods of determining the energy of the halogen-carbon linking are discussed, and it is concluded that this energy must be greater than is usually assumed. It appears that the energy cannot be determined with certainty spectroscopically, but it is proposed to examine the absorption at higher temperatures, at which the chlorides at least should be moderately stable. T. H. P.

2429. Absorption Band of Ozone between 3050Å and 2150Å. Ny Tsi-Ze and Choong Shin-Piaw. *Comptes Rendus*, 196. *pp.* 916–918, *March* 27, 1933.—Absorption coefficients are recorded for 194 bands comprised in the wide ultra-violet absorption region of ozone between 3053·5 Å and 2135·9 Å. C. B. A.

2430. Quantum Mechanics of Beryllium Hydride. C. E. Ireland. *Phys. Rev.* 43. *pp.* 329–336, *March* 1, 1933.—The interaction of a normal H atom with a Be atom having the electronic configurations 2*s* 2*s* and 2*s* 2*p*, respectively, has been studied by the application of a modified Heitler-London method. It is shown that for Be in the ^1S atomic state, the resulting $^2\Sigma$ molecular state is repulsive. For Be in the ^3P atomic state, the $^4\Pi$ and $^4\Sigma$ molecular states are repulsive, and the $^2\Pi$ and $^2\Sigma$ states are attractive. For Be in the ^1P atomic state both the $^2\Pi$ and $^2\Sigma$ molecular states are found to be repulsive. However, when the interaction between the $^2\Sigma(^3P + {}^2S)$ and the $^2\Sigma(^1S + {}^2S)$ molecular states is taken into account the lowest $^2\Sigma$ state is found to be attractive. The calculated heats of dissociation for the attractive states are in poor agreement with the extrapolated values from the band system. AUTHOR.

2431. Spectrum of H_2-Bands Ending on $2p^3\Pi$ Levels. Part II. O. W. Richardson and P. M. Davidson. *Roy. Soc., Proc.* 140. *pp.* 25–58, *April* 1, 1933.—A reconstruction and extension of the scheme already put forward [see Abstract 3440 (1931)] for the band systems originating on $3d^3\Sigma$, $3d^3\Pi_{ab}$ and $3d^3\,\Delta_{ab}$ and ending on $2p^3\Pi_{ab}$ levels is given. The new $3d^3\Sigma \rightarrow 2p^3\Pi$ system is essentially the same as that already put forward. The new $3d^3\Sigma \rightarrow 2p^3\Pi$ system is almost identical with Sandeman's scheme [see Abstract 621 (1933)]. New bands are found for the $3d^3\Pi_{ab} \rightarrow 2p^3\Pi$ systems, whilst part of band system ending on $2p^3\Pi$ and coming from the hitherto undiscovered $3s^3\Sigma$ level is also described. The properties of the various levels are discussed and a number of the principal constants are determined. A. H.

2432. Intensities of Band Spectra of Phosphors. H. Nitka. *Ann. d. Physik*, 16. 6. *pp.* 720–744, *March* 1, 1933.—The intensity depends on the metal content and on the temperature of preparation. The broad bands are theoretically resolved by a graphical method depending on the assumption that each single band follows a Gaussian error curve. Thus resolved, the individual bands agree in position with the series formula for excitation absorption given by Schmidt [see Abstract 1955 (1932)]. Monochromatic excitation of a ZnS Mn phosphor with various Hg lines enabled the intensity course of single bands to be followed (after resolution as above), and again justified the above assumption. Measurements on the band widths during decay indicated that the half width remained constant. The decay is not represented by an exponential function. Comparison of intensities of different bands excited by monochromatic light brought out a close relation between absorption and emission. J. E.

2433. Modification of Intensity Distribution in Band Spectrum of Nitrogen. J. Okubo and H. Hamada. *Astrophys. J.* 77. *pp.* 130–140, *March*, 1933.—The modification of the intensity distribution of the nitrogen band spectrum by changes of temperature, pressure, exciting voltage, and current, and the shape of the discharge tube, was observed. Result: the better defined and the sharper is the selective enhancement in the bands with vibrational quantum numbers $v^1 = \sim 6$ and $= \sim 11$ in the first positive bands, and with $v^1 = \sim 0, 1$ in second positive and negative bands, the lower the gas temperature and the smaller the exciting current density. When both are low, these selective enhancements are always observable; the effect is weaker in the negative bands, conspicuous in the others. At very low pressures, the bands from initial levels with higher v^1 are relatively enhanced, as confirmed by G. Herzberg [see Abstract 3230 (1928)], and the maximum in the band group tends towards the band with greater v^1. The observations are related to the auroral nitrogen bands. T. L. M.

2434. Position of the Absorption Spectra of Photochemically-Coloured Alkali Halogen Crystals. H. Fröhlich. *Zeits f. Physik*, 80. 11–12 *pp.* 819–821, *Feb.* 23, 1933.—This is a short mathematical note showing that the empirical result $\nu d^2 = 0\cdot 50$ cm.^{2}sec.$^{-1}$ (ν = frequency of the absorption band of the coloured alkali halogen ; d = lattice constant) obtained by Mollwo [*Gött. Nachr.* 1931, *p.* 97], can be obtained from quantum mechanics. The work of Mollwo was based on that of Pohl and co-workers [see Abstract 3401 (1931)]. The agreement between the experimental and theoretical values of the constant is satisfactory, the former being 0·50 and the latter 0·45. T. B.

2435. Continuous Spectrum of Sodium. H. Hamada. *Phil. Mag.* 15. *pp.* 574–592, *March*, 1933. *Tohoku Univ., Sci. Reports*, 22. *pp.* 31–54, *March*, 1933. *In English.*—It is shown from the results of the investigation of the intensity distribution of the continuous spectrum of sodium, which is generally considered to be the halo of the D-lines, and also of the relative intensity of it to the discrete band systems, under various conditions of excitations, that the same explanation serves to account for the emission of the molecular spectrum of sodium, as for the cases of mercury, cadmium, zinc, and magnesium. H. H. Ho.

2436. Attempts to Observe an Electron Affinity Spectrum. O. Oldenberg. *Phys. Rev.* 43. *pp.* 534–539, *April* 1, 1933.—The failure of previous attempts to observe an electron affinity spectrum (emitted by the combination of neutral, electronegative atoms and electrons) is explained by inadequate experimental methods. On the basis of recent results regarding combination spectra of positive ions and electrons, new attempts have been made to observe the electron affinity of atomic iodine by using three methods (hollow kathode, positive column with addition of a rare gas, glowing filament). No new spectrum was observed. This failure is discussed theoretically. It seems that the capture of electrons by halogen atoms is an improbable process as compared with the combination of positive ions and electrons. AUTHOR.

2437. Continuous Electron Affinity Spectrum of Hydrogen. C. K. Jen. *Phys. Rev.* 43. *pp.* 540–547, *April* 1, 1933.—A wave-mechanical calculation has been made of the intensity distribution in the continuous emission spectrum due to the capture of electrons by normal hydrogen atoms and the coefficient of absorption in the corresponding absorption spectrum due to the neutralisation of negative hydrogen ions. Approximate wave functions for the continuous range of upper energy levels have been combined with the discrete state wave function for H^- given by Hylleraas to give the matrix components for the desired transitions. The computed results are graphically illustrated and their significance discussed. It is shown that an experimental attempt to find the electron affinity emission spectrum of normal hydrogen atoms may encounter at least two difficulties : (1) insufficient intensity compared to that in experiments on the recombination between H^+ ions and electrons, and (2) spectral distribution such that the spectral limit is too diffuse for positive identification. The relation of these results to the interpretation of experiments on the electron affinity spectrum of halogen atoms is discussed. AUTHOR.

2438. Continuous Absorption of Oxygen Between 1750 and 1300 Å and Its Bearing Upon the Dispersion. R. Ladenburg and C. C. van Voorhis. *Phys. Rev.* 43. *pp.* 315–321, *March* 1, 1933.—In connection with recent measurements of the dispersion of oxygen down to 1920 Å [see Abstract 586 (1933)], the continuous absorption of oxygen between 1750 and 1300 Å has been investigated quantitatively with a small fluorite spectrograph by the photographic-photometric method. The results are given in a graph, which shows that the absorption coefficient a as function of the wave number ν has a relatively sharp maximum at $6 \cdot 8 \times 10^4$ cm^{-1} ($\lambda = 1450$ Å) and falls off rather symmetrically on both sides. The maximum absorption coefficient reduced to N.P.T. is about 490 cm^{-1}. The absorption in this region of the spectrum is so strong that during a few minutes exposure a great part of the oxygen disappears, being dissociated and probably absorbed by the metal walls of the tube. By integration of the absorption curve the corresponding f-value is given according to the equation $\int a(\nu)d\nu = \pi N f e^2/mc^2 = (2 \cdot 38 \times 10^7)f$. The f-value calculated from this expression is $0 \cdot 193$ compared with $0 \cdot 202$ calculated from the dispersion measurements. The corresponding resonance wave-length from the dispersion measurements is 1468 in fairly good agreement with the observed position of the maximum of absorption. A dispersion formula which takes into account the distribution of absorption in a continuous band is given, and is applied to the dispersion of oxygen.

AUTHORS.

2439. Fluorescent Excitation of Mercury by the Resonance Frequency and by Lower Frequencies. Part V. (Lord) Rayleigh. *Roy. Soc., Proc.* 139. *pp.* 507–517, *March*, 1933.—On exciting Hg vapour to fluorescence by longer waves than the resonance line it is found that this line is emitted to some extent if the exciting line is $2 \cdot 3$ Å longer, but not when it is 8 Å longer. In the latter case 2^3P_1 atoms are not formed either initially or in the course of subsequent changes. 2^3P_0 atoms are also shown to be absent. It is concluded therefore that with this kind of excitation the mechanism of fluorescence producing the 3300 and 4850 maxima is concerned solely with excited Hg molecules. It is shown that with this case of molecular excitation both the maxima are persistent, that is to say the gas remains luminous long enough to travel under a pressure gradient several cm. away from the place of excitation. When the vapour is considerably superheated, 3300 alone is emitted and shows persistence. Without superheat 4850 appears with little of 3300, and this too is persistent. If, as has been supposed, these maxima are attributed to the 2^3P_1 and 2^3P_0 states of the molecule, it is clear that persistence cannot be peculiar to states which in the atoms are metastable, but occur also in the 2^3P_1 molecule. Incidentally it is shown that self-luminous Hg vapour issuing from a nozzle from a region of high to one of low pressure with the velocity of sound shows very beautifully the stationary vibrations which are usually investigated by a shadow method using an air jet. [For Part IV see Abstract 4280 (1932).]

AUTHOR.

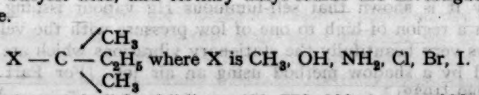
2440. Fluorescence Yield from the L_{III} Level of Uranium. R. J. Stephenson. *Phys. Rev.* 43. *pp.* 527–533, *April* 1, 1933.—The fluorescence yield, defined as the ratio of the number of fluorescence quanta emitted from the L_{III} level to the total number of incident quanta absorbed in the L_{III} level has been measured for uranium; and the value of $0 \cdot 67$ found. The relative intensities of the α to the β-lines in the K fluorescence spectra of molybdenum have been measured and found to agree with the value from the characteristic spectrum. The relative intensities of the α to the β-lines originating from the L_{III} level have been measured in the fluorescence spectrum of uranium, and found to agree with the value from the characteristic spectrum. The atomic absorption coefficients for uranium for wave-lengths including the L_{III} discontinuity have been measured, and a value for $\delta = 2 \cdot 27$ found, where δ is the ratio of the absorption coefficients on the short and long wave-length sides of the L_{III} discontinuity. AUTHOR.

2441. Zeeman Effect of Lead II, III and IV. J. B. Green and R. A. Loring. *Phys. Rev.* 43. *pp.* 459–466, *March* 15, 1933.—The Zeeman effects of Pb II, III and IV, have been studied at fields of about 40,000 gauss with the newly completed outfit at the Mendenhall laboratory. Gieseler's results on Pb II are in general correct, although a few minor discrepancies have been found. The $6d^2D_3$ level shows an anomalous *g*-value which may be attributed to the fact that the $6d^2D$ levels are inverted, or to perturbations caused by neighbouring configurations. In Pb III a similar perturbation is found in the $6s7p$ configuration. Here the *g*-sum of $^3P_1$ and $^1P_1$ is slightly higher than the theoretical value, while the $^3P_2$ level, which should be unaffected by ordinary changes in coupling, yields a value $1 \cdot 35$ instead of $1 \cdot 50$. AUTHORS.

2442. Stark Effect in Hydrogen. L. Kassner. *Zeits. f. Physik*, 81. 5–6. *pp.* 346–362, *March* 22, 1933.—Accurate measurements with high dispersion are given of the separation factor in the lines of hydrogen from H_β to H_δ and for field-strengths of from 50,000 to 100,000 volts/cm. Deviations from the theoretical values are found, and it is shown that the magnitude of the separations, the sharpness of the components and the red-shift all appear to be connected with these deviations. G. C. McV.

2443. Calculation of the Characteristic Vibrations of Organic Chain-Molecule Models. K. W. F. Kohlrausch. *Zeits. f. phys. Chem.* 20. *Abt.B.* 3–4. *pp.* 217–221, *March*, 1933.—The objections, raised in a paper by Bartholomé and Teller [see Abstract 1070 (1933)], to certain deductions made by Kohlrausch are discussed in detail and are not admitted to be of a conclusive nature. J. E. K.

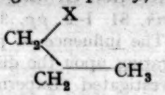
2444. Raman Spectra of Isomeric Paraffin Derivatives. Part II. H. Kopper, R. Seka and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 465–476, 1932.—The results are given for the investigation of 9 isobutyl derivatives, secondary butyl alcohol, isobutyric acid and tertiary amyl iodide. Isobutylamine, isobutyl-iodide, -nitrate, -nitrite, -butyric acid, and tertiary amyl iodide are investigated for the first time.



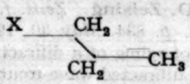
$$X - C \begin{matrix} \diagup CH_3 \\ - C_2H_5 \\ \diagdown CH_3 \end{matrix} \text{ where X is } CH_3, OH, NH_2, Cl, Br, I.$$

gives rise to certain " fixed " lines, 480, 770, 800 strong ; 920, 1050, 1130 medium ; and 370, 1170, 1270, 1330 weak, all in cm^{-1}. [For Part I see Abstract 5026 (1932).] A. C. M.

2445. Raman Spectra of Isomeric Paraffin Derivatives. Part III. A. Dadieu, A. Pongratz and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 8. *pp.* 477–492, 1932.—Results are given for normal amyl- and isoamyl- alcohol, amine, mercaptan, chloride, bromide, and iodide. These and other former results are discussed with special reference to the C — X linkage where X is a halogen. It is shown that there is only *one* such frequency for methyl, ethyl, isopropyl and tertiary butyl halides, and *two* for, *e.g.*, *n*-propyl, secondary butyl, tertiary amyl halides. This is explained as arising from " free-rotation " of the C — X bond; there can exist ring-form (higher frequency) and open-form (lower frequency) chain molecules, *e.g.*,



and



respectively. Further, the magnitude of the frequency is found to depend upon the number of hydrogen atoms attached to the C atom linked to the halogen; C — X has a high value for $CH_3 - X$, and less progressively for $- CH_2 - X$, $- CH - X$, $- C - X$. [For Part II see preceding Abstract.] A. C. M.

2446. Depolarisation of Raman Lines from Liquids. J. Cabannes and A. Rousset. *Ann. de Physique*, 19. *pp.* 229–303, *March*, 1933.—The first part is concerned with a description of the apparatus used and the precautions necessary for accurate work. A real image of the mercury vapour lamp is thrown on to a diaphragm, and another similar lens throws a real image of this into a tube from the side. This permits of varying the effective intensity of the source by varying the diaphragm opening. The scattered light is projected on to the collimator slit through a calcite crystal and correcting slice of mica, which transforms each of the rectilinear vibrations into an elliptical vibration having equal vertical and horizontal components, so eliminating the spectrograph correction. The intensities are determined by (1) with constant time of exposure, varying the intensity of the Raman lines by altering the diaphragm between source and tube, and thus obtaining intensity marks; (2) using the previously measured intensity-ratio of λλ4358, 4347 and 4339; and (3) comparing the intensities of corresponding Stokes and anti-Stokes lines. In the second part, results are tabulated for 27 liquids. In the third part, the structure of the following molecules and radicals are discussed in the light of the observed depolarisations —CS_2, SO_2, NO_2 radical, CH_2 radical, H_2O, PCl_3, PBr_3, $SOCl_2$, CCl_4, $SiCl_4$, $TiCl_4$, $SnCl_4$, $POCl_3$, $CHCl_3$, $CHBr_3$, SO_2Cl_2, CH_2Cl_2, CH_2Br_2, CH_3Cl, CH_3Br, CH_3I, C_6H_6. A. C. M.

2447. Raman Spectra of Unsaturated Cyclic Hydrocarbons. M. Godchot, E. Canals and Germaine Cauquil. *Comptes Rendus*, 196. *pp.* 780–781. *March* 13, 1933.—The principal lines in the Raman spectra of cyclo-pentene, -hexene, -heptene and -octene are recorded. In general the spectra resemble those of the corresponding saturated hydrocarbons, but there is a line at 1600 cm^{-1}. due to the double bond. The CH_2 line at 1440 cm^{-1}. is of approximately the same intensity in all cases, and there is a strong line at 1205–1271 cm^{-1}. which occurs in the spectra of the corresponding saturated cyclic compounds, but not in those of the straight-chain compounds. In the neighbourhood of 800 cm^{-1}. there occurs a strong line of which the frequency is proportional to $n^{-0.5}$, n being the number of carbon atoms in the ring. H. F. G.

2448. Raman Effect and Ethylenic Linkage: Hexenes. (Miss) H. van Risseghem, (Miss) B. Gredy and L. Piaux. *Comptes Rendus*, 196. *pp.* 938–940, *March* 27, 1933.—The Raman spectra between 1250 and

1700 cm.$^{-1}$ (omitting the band near 1450) of Δ^{α}- and Δ^{β}-(cis and trans)-hexenes; δ-(cis and trans)-methyl-Δ^{β}-, γ-methyl-Δ^{β}-, and δ-methyl-Δ^{γ}-pentenes and $\beta\gamma$-dimethyl-Δ^{β}-butene show lines at 1252–1262, 1296–1306, 1350–1416, and 1642–1676. These are in conformity with and extension of Bourguel's results. [See Abstract 3748 (1932).] C. A. S.

2449. Ruling Errors of Diffraction Gratings. P. H. Brodersen and O. Zeising. *Zeits. f. Physik*, 81. 1–2. *pp.* 3–6, *March* 3, and 82. 11–12. *p.* 834, *May* 30, 1933.—The influence of periodic and aperiodic error of ruling of a diffraction grating upon the distribution of intensity in the diffracted wave-front is investigated. Experimental results confirm that the structure of the wave-front is caused in the same manner as the Rowland ghosts. F. S.

2450. Spectra of Potassium and Sodium in the Mercury Arc. D. A. Wells and I. Balinkin. *J.O.S.A.* 23. *pp.* 105–108, *March*, 1933.—In earlier work [see Abstract 4260 (1932)] a simple mercury arc in pyrex has been described, and work is now described in which the mercury is replaced by a mercury-alkali metal amalgam. The construction and filling of the lamps is given in detail, whilst the spectra obtained are described. Under carefully controlled conditions an intense potassium or sodium glow is obtained whilst the mercury spectrum is greatly reduced in intensity. A. H.

2451. Photographic Method of Measuring the Relative Intensities of Spectral Lines. K. B. Thomson and O. S. Duffendack. *J.O.S.A.* 23. *pp.* 101–104, *March*, 1933.—A method for measuring the relative intensities of spectral lines is described in which a step diaphragm is substituted for the slit of a spectrograph. A continuous source of light then produces on the photographic plate a set of bands over which the intensity of the light varies as the widths of the openings in the step diaphragm. Necessary precautions in the use of the method are noted. Results from this method are compared with those obtained by varying the distance to the source. Possible errors in measurements on relative intensities of spectral lines due to the Eberhard effect and to the use of an intermittent source are mentioned. AUTHORS

2452. Calibration of an Infra-Red Spectrometer with a Rock-Salt Prism. P. C. Cross. *Rev. Sci. Instruments*, 4. *pp.* 197–199, *April*, 1933.—The dispersion data for rock-salt originally determined by Paschen are corrected to 25° C. with the use of temperature coefficients derived from the measurements of Liebreich. Values of the angle of minimum deviation of a 60° prism and the prism table angles from the sodium D lines for a spectrometer with the Wadsworth mounting of a 60° prism and plane mirror are calculated for 25° C. Tables are given with which corrections may be easily made for temperatures other than 25° C. and for prism angles between 59 and 61°. AUTHOR.

See also Abstracts 2220, 2221, 2344, 2362, 2365.

VISION.

See Abstracts 2264, 2340, 2376.

X-RAYS.

2453. H.T. Porcelain X-Ray Tube. R. Crane and C. C. Lauritsen. *Rev. Sci. Instruments*, 4. *pp.* 118–122, *March*, 1933.—An X-ray tube which operates successfully up to 650 kV has been constructed from a conical porcelain transformer bushing, rated at 750 kV external flashover. Although the bushing had previously been filled with transformer oil, no difficulties were encountered in out-gassing the inner surface. With a pumping system of about 300 litres per sec. capacity, a vacuum of 10^{-5} mm. can be maintained, and this does not change appreciably during operation. Cold emission from the anode, rather than gas current or breakdown of the porcelain, limits the voltage which can be applied. Filament emission currents up to 4 milliamperes can be employed without undue heating of the target. For a given voltage, a porcelain tube of this type is much more compact than a glass tube, the strength of its walls against puncture makes elaborate internal shielding unnecessary, and there is no more difficulty in maintaining a good vacuum than in a glass tube of comparable volume. AUTHORS.

2454. Linear Momenta of Electrons in Atoms and in Solid Bodies as Revealed by X-Ray Scattering. J. W. M. DuMond. *Rev. Modern Physics*, 5. *pp.* 1–33, *Jan.*, 1933.—The purpose of the author is to describe a series of related experiments revealing a new physical effect predicted by him in 1929. It is claimed that the predictions have been completely verified experimentally. A very simple interpretation of the results is given which appears to support the view of the dynamical nature of the atom. Among the sections of this lengthy paper special attention is directed to the spectral broadening of modified scattered X-radiation regarded as a Doppler broadening ; quantum mechanical theory of modified scattering by bound electrons ; experimental evidence for the broadening of the modified line ; momenta of conduction electrons in beryllium ; the multi-crystal spectrograph ; momentum distribution in carbon. The experiments described are regarded as giving evidence of the presence of the linear momenta of the electrons in the atom as well as of the momenta of the " free " electrons in metals. H. L. B.

2455. Efficiency of Production of Fluorescent K-Radiations from Light Elements. M. Haas. *Ann. d. Physik*, 16. 4. *pp.* 473–488, *Feb.*, 1933.—Six elements have been investigated : Mg, Si, S, Cl, Ca and Cr. With Mg and Si different excitation wave-lengths were used in order to find whether there were any dependence on the exciting frequency. The results are in agreement with Wentzel's theory, $U = (Z - 1)^4/\{a + (Z - 1)^4\}$ where U=efficiency, Z=atomic number, and a=probability constant of internal absorption. A description of the experimental arrangements and a discussion of the theory are given. J. E.

2456. Relative Ionisation in Air, Nitrogen, Oxygen and Argon for Cu K_α Radiation. O. Gaertner. *Ann. d. Physik*, 16. 5. *pp.* 613–624, *March*, 1933.—Two ionisation chambers are used in series. The second is filled with argon and the first with whichever of the other gases is being investigated. The ionisation in both chambers is measured for different pressures in the first chamber. The method gives the ionisation relative to that of argon in volts per ion pair, the absorption coefficient, the true absorption coefficient and the scattering coefficient. Using the value for argon of 28·8 volts per ion pair, the values for air, nitrogen and oxygen work out to be $35 \cdot 49 \pm 0 \cdot 17$, $39 \cdot 31 \pm 0 \cdot 20$ and $32 \cdot 95 \pm 0 \cdot 22$ respectively. J. T.

2457. M-Levels of Magnetised Iron. Privault. *Comptes Rendus*, 196. *pp.* 854–856, *March* 20, 1933.—Application of a field of 5000 gauss to an iron anti-kathode caused no difference in visible appearance and did not affect the emission of X-rays, the greatest difference detectable in the wave-lengths of $K\beta_1$ or $K\beta_5$ was $+0\cdot12$X, average $+0\cdot025$X, and in the energies of the levels M_3 and M_5 of $0\cdot12$ and $0\cdot14$ electron volt respectively. C. A. S.

2458. Quadripole Lines in X-Ray Spectra. E. Segrè. *Accad. Lincei, Atti*, 16. *p.* 442, *Nov.* 6, 1932.—Summary of observations tending to confirm the attribution of prohibited rays in X-ray spectra to quadripoles. [See Abstract 1643 (1932).] A. D.

2459. Effect of Lattice Distortion and Fine Grain on the X-Ray Spectra of Metals. W. A. Wood. *Phil. Mag.* 15. *pp.* 554–562, *March*, 1933.—An attempt is made to differentiate between the effects of fine grain and of lattice distortion on the X-ray spectrum of a metal. A method is suggested for calculating the proportionate contribution of each factor to the broadening of the X-ray diffraction lines. The results are applied to the particular case of electrodeposited nickel; it is shown that both factors must be taken into account in considering the observed diffusion of the X-ray spectra of nickel in this form. AUTHOR.

2460. Application of Radiography in Relation to Paintings. L. van Puyvelde. *J. de Radiologie et d'Électrologie*, 17. *pp.* 83–90, *Feb.*, 1933.—Application of radiography, to determine whether old paintings are authentic, is based on the difference of X-ray absorption of the metallic salts used in the pigments and recognition whether such pigments were available at the period of execution. Generally the earlier painters used pigments of metals of high atomic weight, such as salts of mercury and lead. The author illustrates how X-ray investigation may be applied, in order to determine whether a canvas has been re-painted, particularly in respect to a particular painting, in which a portrait had been painted over an earlier picture, the original painting being shown restored. B. J. L.

2461. Quantitative Chemical Analysis by Means of X-Rays. F. Voges. *Zeits. f. Physik*, 80. 7–8. *pp.* 542–556, *Feb.* 6, 1933.—Describes improved methods which in two or three hours reach results correct to a few tenths per cent; the intensities are measured by air-ionisation, using Küstner's method of obtaining monochromatic X-rays. A. D.

2462. Spectrography of X-Rays Using a Divergent Beam. Y. Cauchois. *J. de Physique et le Radium*, 4. *pp.* 61–72, *Feb.*, 1933.—Describes an X-ray spectrometer constructed according to a method previously described [see Abstract 4059 (1932)]. X-rays from an extended source are transmitted by a curved crystalline lamina such as mica or gypsum. In this way suitable resolving power is obtained in conjunction with high intensity. The technique of measurement with this apparatus is described. Some crystalline constants of mica are obtained and the errors involved in their measurement are discussed. Various spectra are reproduced in the paper. J. E. R. C.

2463. Large Grazing-Incidence Vacuum Spectrograph. P. G. Kruger. *Rev. Sci. Instruments*, 4. *pp.* 128–130, *March*, 1933.—The construction and adjustment of a grazing-incidence vacuum spectrograph (angle of incidence 79°) for a grating of 21 ft. focal length are described. Very sharp lines have been obtained, and spectrograms of copper show to great advantage when compared with those taken on a 1-metre grating. Several groups of lines observed appear to be multiplets, but have not been classified. Work is being continued on Be, B, Al, Cu, Ni, Co, and Zn. C. B. A.

See also Abstracts 2107, 2137, 2156, 2157, 2328, 2356, 2366, 2637, 2648 2654, 2655.

HEAT.

CALORIMETRY.

2464. Heat Capacity Data for Durene, Penta-methylbenzene, Stilbene and Dibenzyl. J. D. Ferry and S. B. Thomas. *J. Phys. Chem.* 37. *pp.* 253–255, *Feb.*, 1933.—Values are given for the specific heat (in the solid and liquid states) and for the latent heat of fusion of the four substances. The temperature range covered is from 30° to 130° C. L. G. C.

2465. Molecular Heats and Normal Oscillations of Ethane and Ethylene. A. Eucken and A. Parts. *Zeits. f. phys. Chem.* 20. *Abt.B.* 3–4. *pp.* 184–194, *March*, 1933.—The molecular heats of ethylene and ethane have been determined as accurately as is possible by the Lummer-Pringsheim method between 178–464° and 189–373° Abs. respectively. The C_p-values for ethylene, reduced to $p = 0$, are introduced into the Planck-Einstein formula, together with spectroscopic data, to give the frequency values for the normal oscillations, under the assumption of a frequency of 750–800 $cm.^{-1}$ for the two CH_2-radicals with respect to each other. The analogous values for ethane, indicate free rotation of the CH_3 radical. [See also Abstract 4422 (1932).] H. H. Ho.

2466. Physical Properties of Ethylamine. E. Pohland and W. Mehl. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 48–54, *March*, 1933.—The saturation vapour pressure, pressure in mm. of mercury, at temperatures T° Abs., between $211 \cdot 9_1$° Abs. and $297 \cdot 0_1$° Abs. are given by the equation $p = 21 \cdot 5535 - (2093 \cdot 686/p) - 4 \cdot 61703 \log T - 2 \cdot 74 \times 10^{-4} T$. The boiling point is $16 \cdot 5_1$°C., the melting point, $- 81 \cdot 0$°C. The specific gravity S of ethylamine at temperatures T° Abs., between $200 \cdot 5_5$°Abs. and $292 \cdot 6_0$° Abs., is given by $S = 0 \cdot 9763 - 0 \cdot 8478 \times 10^{-3} T - 0 \cdot 518 \times 10^{-6} T^2$. The specific gravity of the solid at the melting point is 0·898; that of the liquid at the melting point is 0·7942, and at the boiling point is 0·6872. The calculated value of the molecular diameter is 5·41Å. The value of the parachor is 138·9. The specific gravity of the saturated vapour was found to be 1·0016 gm./litre at − 0·1°C., 1·2308 gm./litre at 5·0°C. and 1·6733 gm./litre at 12·15°C. The critical density is 0·2483 at the critical temperature 183·4°C. The value of the Eötvös constant is 1·9, indicating very slight association. The heat of evaporation at the boiling point is 6·53 k.cal./mol.; the specific heat of the liquid is 31·1 cal./mol. ± 0·9. The value of Trouton's constant is 22·5. J. S. G. T.

2467. Heat Capacity and Related Thermodynamic Properties of Aqueous Solutions. Part II. Lithium and Sodium Hydroxides. F. T. Gucker, Jr., and K. H. Schminke. *Am. Chem. Soc., J.* 55. *pp.* 1013–1019, *March*, 1933.—Continuing previous work [see Abstract 3339 (1932)] the adiabatic twin calorimeter was employed to determine the specific heats of aqueous solutions of lithium and sodium hydroxides at 25°C. at concentrations of 0·04 *N.* to 2 *N.* From the data the apparent molal heat capacity of the solutes was calculated. F. J. B.

2468. Extra Specific Heat in Cuprous Sulphide; Specific Heat of Ferrous Oxide. W. P. White. *Am. Chem. Soc., J.* 55. *pp.* 1047–1053, *March*, 1933.—Results of determinations of the mean specific heat of cuprous sulphide over six intervals of 100°C. between 300° and 900°C. are given. For an interval of several hundred degrees around 300°C. cuprous sulphide has an abnormally high specific heat (some 3 cal. per gm. in excess), although there is no corresponding change of state. The mean specific heat of ferrous oxide has been determined for the intervals 30°–700°C. and 30°–900°C.; the true specific heat is given by $0 \cdot 17508 + 0 \cdot 000027T$. H. F. G.

2469. Specific Heats of Tungsten, Molybdenum and Copper. H. L. Bronson, H. M. Chisholm and S. M. Dockerty. *Canad. J. of Research*, 8. *pp.* 282–303, *March*, 1933.—This paper contains the results of a long series of determinations of the specific heats of tungsten, molybdenum, and copper from − 20° to 500°C. A new type of all-copper adiabatic calorimeter has been designed and used. The complete elimination of water from the calorimeter removed several sources of error and resulted in increased reliability and accuracy. Two entirely different methods were used in determining the specific heats. The usual "method of mixtures" was used to determine the mean specific heat for a large temperature change and was applied to all three metals over the entire range of temperature. The specific heat of copper was also determined for 5- or 10-degree intervals from − 5° to 110°C. by heating the calorimeter electrically. It has been quite definitely shown that the specific heats of these metals over a temperature range as large as 0° to 500°C. cannot be expressed as a linear function of the temperature. An equation of the form $C_p = A + BT - C/T^2$ was arrived at from theoretical considerations and the constants determined empirically with the following results :—

Tungsten $C_p = 0 \cdot 03199 + 0 \cdot 00000328T - 129/T^2$
Molybdenum $C_p = 0 \cdot 06069 + 0 \cdot 0000120T - 361/T^2$
Copper $C_p = 0 \cdot 09292 + 0 \cdot 0000136T - 452/T^2$

where the unit of heat is the 20-degree calorie and T is absolute temperature. The average deviation of the individual determinations from the values calculated by these equations was only about 0·1 %. As a matter of convenience and for purposes of comparison, linear equations applicable over smaller ranges of temperature have also been given. AUTHORS.

2470. Determination of the Specific Heats of Liquids. A. Ferguson and J. T. Miller. *Phys. Soc., Proc.* 45. *pp.* 194–204 ; *Disc.*, 204–206, *March* 1, 1933.—The specific heats of aniline and benzene are determined by measuring the electrical power E^2/R necessary to hold the temperature of a calorimeter and its contents steady at various temperature-excesses θ. A cooling curve is then taken in order to evaluate the constant K in the equation $(MS+W)K\theta^{5/4}=E^2/RJ$, where S is the specific heat of the liquid at a temperature θ above that of the surroundings. The specific heat of aniline at any temperature T between 20° C. and 50° C. is given by $S=0 \cdot 495_0+0 \cdot 000275\ (T-20)=0 \cdot 0000035\ (T-20)^2$, and that of benzene by $S=0 \cdot 395_8+0 \cdot 00125\ (T-20)$. AUTHORS.

See also Abstracts 2493, 2500, 2619.

CONDUCTION.

2471. Theory of Thermal Conduction at Low Temperatures. W. Kroll. *Zeits. f. Physik*, 81. 7–8. *pp.* 425–427, *March* 30, 1933.—An expression for the coefficient of thermal conductivity at low temperatures is derived by an application of Bloch's theory and is found to conform satisfactorily with experimental results relating to lithium. J. S. G. T.

2472. Thermal Insulation. P. Vernotte. *Comptes Rendus*, 196. *pp*. 680–682, *March* 6, 1933.—Theoretical considerations entering into the discussion of the design of the thermal insulation of a refrigerating chamber of diameter 2 metres and 3·5 metres long are briefly discussed. J. S. G. T.

2473. Exchange of Energy between Polyatomic Molecules and a Metallic Surface. F. R. Whaley. *J. Chem. Phys.* 1. *pp*. 186–189, *March*, 1933.—Experimental evidence is given to show that fairly complicated molecules, on striking a hot surface, do not absorb energy in their vibrational degrees of freedom to any appreciable extent. In regard to the energy interchange the molecules behave like hypothetical gases of six degrees of freedom, translational and rotational. AUTHOR.

See also Abstracts 2474, 2475.

CONVECTION.

2474. Heat Transmission to and from Tubes set Perpendicular to a Stream of Air. J. T. M'Intyre. *Roy. Techn. Coll. Glasgow, J.* 3. *pp*. 86–105, *Jan.*, 1933.—The heat exchange between metal pipes of diameter 0·24 and 0·41 in. and a current of air travelling at speeds up to 250 ft. per sec. has been measured. The pipe temperatures varied from 30 to 90° C. and the air temperature from 15 to 135° C., being in some cases below and in some cases above that of the pipe. The results are correlated by means of the principle of similitude, and examples of calculations for design work are given. J. H. A.

2475. Transmission of Heat from Honeycomb Radiators. J. Caldwell. *Roy. Techn. Coll. Glasgow, J.* 3. *pp*. 79–85, *Jan.*, 1933.—The uncertain value of the air speed through the elements of the honeycomb type of radiator renders the calculation of heat transmission in these elements of doubtful accuracy. It is shown how a value for this air speed can be obtained from certain features of the air flow, and using Nusselt's heat transmission formula for inlet lengths an expression for the heat transmitted by a complete radiator is obtained. It is in good agreement with test results. From this expression the best performance from the heat transfer point of view is shown to be obtained using elements with a length/diameter ratio of about 40. AUTHOR.

DILATATION.

2476. Thermal Expansion of Manganin. A. Schulze. *Zeits. f. techn. Physik*, 14. 2. *p*. 89, 1933.—As no data were to be found in the literature for the thermal expansion of manganin and this alloy (86 parts by weight copper, 12 manganese and 2 nickel) is largely used for standard resistances, the author has determined its thermal expansion. A rod of the metal 22 cm. in length and 5 mm. in diameter was used for the measurements. The results obtained are well represented by the equation, $\Delta l = 1 \cdot 77\ (t/100) + 0 \cdot 035\ (t^2/100^2)$. The linear coefficient of expansion is found to be as follows: interval 20° − 100° C., 18·1; 20° − 200°, − 18·5; 20° − 300°, 18·9; 20° − 400°, 19·3; 20° − 500°, 19·6. (The unit of the coefficient is 10^{-6}.) T. B.

2477. Universal Dilatometer. R. Holcomb. *Science*, 77. *pp*. 261–263, *March* 10, 1933.—An instrument is described for direct observation of volume changes during chemical reactions in solution. A. S. C. L.

See also Abstract 2482.

EVAPORATION.

See Abstracts 2483, 2484.

MELTING AND BOILING POINTS.

2478. Fusion Curves for the Systems Ammonia-Propyl Alcohols and Ammonia-Butyl Alcohols. H. P. Cady and Ethel A. Jones. *J. Phys. Chem.* 37. *pp.* 303–320, *March,* 1933.—The phase law method was applied to systems of ammonia and some alcohols of the aliphatic series. Fusion curves for the systems indicated the formation of compounds, together with their melting points, composed of one mole of acid and one mole of ammonia in each of the following cases : *n*-propyl alcohol, − 77·1° ; isopropyl alcohol, − 71·9° ; *n*-butyl alcohol, − 60° ; isobutyl alcohol, − 59·1° ; secondary butyl alcohol, − 60° ; tertiary butyl alcohol, − 43·9°. Faint indication of other compounds was obtained. The dissociation of the compounds formed is in the order : primary alcohol-ammonia, relatively undissociated ; secondary alcohol-ammonia, slightly more dissociated ; tertiary alcohol-ammonia, relatively highly dissociated. The melting point of secondary butyl alcohol, not being available in the literature, was determined as − 114·7°. N. M. B.

2479. Freezing Points of Solutions of Nitrobenzene in Benzene and Cyclohexane, and their Relations to the Electrical Polarisation. L. G. Davy and N. V. Sidgwick. *Chem. Soc., J. pp.* 281–286, *March,* 1933.—The results in benzene solution show that as the concentration increases the activity of the solute molecules diminishes ; this is accompanied by a corresponding fall in the molecular polarisation. This parallel fall is fully explained by the orientation of the polar molecules under the influence of their mutual attractions. In cyclohexane there is a new phenomenon ; the polarisation data indicate that the electrical behaviour of nitrobenzene will be much the same as in benzene, but the cryoscopic measurements point to a far higher degree of association. This suggests that in cyclohexane the freezing points are affected by a new factor, which clearly is the tendency of the system to separate into two liquid layers, *i.e.*, the effect of the highly positive partial vapour pressure curve of cyclohexane in presence of nitrobenzene. Such a curve involves a complete breakdown of Raoult's law, and leads to values of the molecular weight from the freezing point far in excess of the truth. H. H. Ho.

2480. Apparatus for Determination of Dew Point and Boiling Point of Mixtures of Volatile Liquids. L. Gay and J. Soulié. *Comptes Rendus,* 196. *pp.* 776–777, *March* 13, 1933.—The apparatus is described and illustrated ; it has three principal advantages : when the measurements are made the liquid and vapour phases are in equilibrium ; the temperature is uniform in the two phases ; and a truly representative sample may be taken from the vapour phase. An electric immersion heater is used, and the apparatus may be used at atmospheric or reduced pressure. H. F. G.

2481. Boiling Point Elevation of Concentrated Milk Solutions. A. W. Scott. *Roy. Techn. Coll. Glasgow, J.* 3. *pp.* 116–120, *Jan.,* 1933.—Boiling point elevation of viscous concentrated milk solutions is measured under reduced pressure. A. S. C. L.

2482. Physical Properties of Compounds of High Melting Point. K. Becker. *Phys. Zeits.* 34. *pp.* 185–198, *March*, 1933.—A review of a very comprehensive character of the physical properties of metallic carbides and alloys thereof used for lamp filaments and the like. The paper gives full details of experimental procedure and is divided into four sections covering the preparation of the amorphous compounds, *e.g.*, carbides, nitrides and borides, their purification, and the preparation of samples for the tests employed. The density, lattice structure, hardness, elasticity, melting point, vaporisation temperature, thermal expansion, electrical resistance and supraconductivity, electron emission, magnetic properties and optical characteristics are measured and values quoted. The work is then diverted to an investigation of physical properties of alloys in the binary and tertiary carbide systems as also the carbide-nitride system, and, finally, the alloys of tungsten carbide with cobalt and also tantalum carbide are reviewed. The results are applied to incandescent lamp technique and are too comprehensive and detailed to be abstracted. S. G. B.

2483. Apparatus and Methods for Precise Fractional-Distillation. W. J. Podbielniak. *Indust. and Engin. Chem.* (*Analytical Edition*), 5. *pp.* 119–142, *March* 15, 1933.—Fractionating columns are described with a metal vacuum jacket as insulation. One jacket can be used with a variety of inner tubes according to the nature and quantity of liquid to be distilled. The packing is a spiral wire coil. In the second part, attention is particularly directed to distillation under reduced pressure. J. H. A.

2484. Computation of Distillation Apparatus for Hydrocarbon Mixtures. E. W. Thiele and R. L. Geddes. *Indust. and Engin. Chem.* 25. *pp.* 289–295, *March*, 1933.—The authors submit a method of computation for the solution of column problems involving complex mixtures obeying Raoult's law or its simple modifications. The components, the number of which may be either finite or infinite, are assumed to have a constant plate efficiency. Consideration is also given to cases where side streams are drawn from the column, or the feed is admitted at more than one point. From the equations deduced the authors point out that it is now possible to compute the performance of a proposed column, so that the design of equipment, so far as reflux ratio and number of plates are concerned, will no longer have to depend on experience only. J. K.

TEMPERATURE, MEASUREMENT OF.

2485. Reference Tables for Platinum to Platinum-Rhodium Thermocouples. W. F. Roeser and H. T. Wensel. *Bureau of Standards, J. of Research,* 10. *pp.* 275–287, *Feb.*, 1933.—Reference tables for use with platinum to platinum-10 % rhodium and platinum to platinum-13 % rhodium thermocouples have been prepared. When these tables are used, the deviation curves obtained for individual couples, have no points of inflection and are, with few exceptions, linear. These tables are based on the International Temperature Scale, so that the indications of a thermocouple whose calibration is obtained by extrapolation of a deviation curve above the gold point will agree in this region with those of an optical pyrometer. AUTHORS.

2486. Noble Metal Thermoelectric Thermometer for Very High Temperatures. O. Feussner. *E.T.Z.* 54. *pp.* 155–156, *Feb.* 16, 1933.—A thermoelectric element, one wire being of iridium with 10 % ruthenium, and the other wire of an alloy of iridium with 10 % rhodium is capable of attaining temperatures up to 2000° C., but is not robust and is expensive. The author now describes a successful thermo-junction, one leg of which is of pure iridium and the other of an alloy of 40 % iridium and 60 % rhodium. This gives a linear curve for e.m.f. and temperature up to 2000° C., and, as there is very little vaporisation of the metals at these high temperatures, frequent calibration is not necessary; further, its mechanical strength and moderate price are both in its favour.

W. C. S. P.

2487. Registering Photoelectric Cell Pyrometer. G. Müller and H. J. Zetzmann. *Zeits. f. techn. Physik,* 14. 2. *pp.* 90–94, 1933.—The authors use a combination of a caesium photoelectric cell with an amplifier and a loop oscillograph for instantaneous records of high temperatures, *e.g.*, in the welding of copper, where the high temperature is quickly dissipated. A device is added which automatically switches off the welding current and recorder after the welding is completed. E. E. F. d'A.

2488. Theory of Temperature Control. M. Lang. *Zeits. f. techn. Physik,* 14. 3. *pp.* 98–105, 1933.—A theory of temperature control is outlined, and its aims and limitations are discussed. By the use of new theoretical conceptions, equations are formed which describe the processes of continuous and discontinuous temperature control and lead to conclusions of use in the construction and adjustment of thermostats. Practical cases are considered. G. G. S.

2489. Automatic Apparatus Assembly for Thermal Analysis. C. T. Eddy. *Rev. Sci. Instruments,* 4. *pp.* 200–205, *April,* 1933.—The apparatus described was developed to make possible a determination of thermal critical temperatures and the temperatures at which allotropic modifications take place, etc.; such determination to be accurate enough to be the basis for investigating the constitution and for determining or modifying heat treating practices for alloys. The assembly has been found satisfactory because of its flexibility and degree of accuracy and because of the ease with which it is operated, the arduous task of constant observation by a laboratory technician not being required as in the case of most similar apparatus. In addition, the apparatus is flexible and can be used for investigating other properties such as resistivity and thermoenergy. The records are made automatically and are sharp and easily read and interpreted. The important parts of the apparatus are standard, easily obtained and readily assembled; this constitutes an additional and important advantage. AUTHOR.

2490. Apparatus for Recording the Rate of Cooling of a Kata-Thermometer. C. P. Black. *Journ. Sci. Instruments,* 10. *pp.* 101–105, *April,* 1933.—During the course of an investigation it was necessary to record the change in the rate of cooling of a kata-thermometer, when a cloth was applied to its bulb, at an instant when the alcohol stood at a certain level in the stem of the kata. An apparatus is described by which the cloth is applied, the time noted, and recording started, all at the same instant. A record of the rate of cooling is made in the form of a simple harmonic wave trace, a drum being made to oscillate in accordance with the movements of a suitable pendulum, while the pen moves axially on the drum at the rate of fall of the liquid in the thermometer. AUTHOR.

See also Abstracts 2494, 2527.

THERMOCHEMISTRY.

2491. Heat of Dilution and Heat Capacity of Zinc Sulphate from the E.M.F. of Galvanic Cells. V. K. La Mer and I. A. Cowperthwaite. *Am. Chem. Soc., J.* 55. *pp.* 1004–1013, *March,* 1933.—From e.m.f. measurements of the cell Zn (saturated amalgam), $ZnSO_4(m)$, $PbSO_4(s)$, Pb (saturated amalgam) at temperatures of 0°, 12·5°, 25°, 37·5°, and 50° C. and at concentrations of 0·0005 to 0·01 *M.* zinc sulphate, the partial molal heat of dilution is obtained. For the standard state, that is at infinite dilution in water, the value is −107 cal. per degree per mole. F. J. B.

2492. Energy Values of Valency Bonds in Organic Compounds. J. A. Clopatt. *Soc. Scien. Fennica,* 6. 23. *pp.* 1–18, 1932–1933. *In German.*—The present investigation is based partly on published data of heats of combustion and on the binding energies of molecules obtained from the author's crystal lattice studies. The following values in calories are given: C-C in the diamond lattice (68), C-H (88), C-C in hydrocarbons with branching chains (68·6), C=C (113·4), C=C from hydrocarbons with unsaturated groups (124·7), C=C (145·2), C-O in ethers (86·6), CH_2O H (389·8) C = O in ketones (185·4), CHO (269·5), COOH (419·9), C-O-C=O in acid esters (380·5), CCl (105·2), C Br (60·2), C I (47·6), N-C (71·6), N-H (98·0), C≡N (211·3), C=N (258·3), C-C in the benzene ring (96·0), C-H in benzene (87·7), C-C nucleus-side chain in benzene (70·1), C-C union between two benzene nuclei (81·9), C-O-H in aromatic alcohols (213·6), C-O-H in phenols (222·9). H. H. Ho.

2493. Thermochemical Constants of the Hexafluorides of Sulphur, Selenium and Tellurium. D. M. Yost and W. H. Claussen. *Am. Chem. Soc., J.* 55. *pp.* 885–891, *March,* 1933.—The vapour pressures for the solid over a range of temperatures, the melting points and sublimation points of selenium and tellurium hexafluorides, and the heats of formation for, in addition, sulphur hexafluoride have been determined. The resulting calculated heats of formation (A), heats of sublimation (B), heats of fusion of the solid (C), and sublimation points (D) are:

	A	B	C	D	M.P.
SF_6	262000	5640	1390	−63·8°	−50·8°
SeF_6	246000	6600	2010	−46·6°	−34·6°
TeF_6	315000	6740	1900	−38·9	−37·8°

Selenium hexafluoride reacts with ammonia gas slowly at 200° and more rapidly at 330°, to give selenium, nitrogen and hydrogen fluoride. This, together with the thermal data shows that the inertness of the hexafluorides towards reducing agents is not due to a lack of thermodynamic tendency to react. A lower liquid fluoride of tellurium of undetermined composition was discovered. N. M. B.

2494. Effect of an Electric Field on the Flame Temperature of Combustible Gas Mixtures. B. Lewis and C. D. Kreutz. *Am. Chem. Soc., J.* 55. *pp.* 934–938, *March,* 1933.—Data for the effect of an electric field applied transversely across a flame, on the flame temperatures of rich and weak mixtures, and mixtures close to the theoretical oxygen content, of Pittsburgh natural gas, ethylene, isobutane and butylene, with air, using the sodium line reversal method for measuring flame temperatures, showed in all cases a reduction of flame temperature. This was greater the slower the gas velocity and the greater the length of flame exposed to the field before observations were made. The effect was most marked for weak mixtures, and least for rich mixtures, the extremes for ethylene being 116° and 12°. For carbon disulphide vapour a low-temperature flame was unaffected by an electric field, but a high-temperature flame was deflected towards the negative electrode, as were the flames of other combustibles.

N. M. B.

2495. Explosive Properties of Acetone-Air Mixtures. G. W Jones, E. S. Harris and W. E. Miller. *Bureau of Mines, Techn. Paper, No.* **544** [26 *pp.*], **1933.**—The explosive limits for both dry and undried mixtures of air and acetone have been determined at temperatures up to 230° C. The apparatus used was a steel bomb of internal diameter 4 in. and length 38 in. Ignition was by means of a spark at the base of the bomb, which was used in a vertical position. Turbulence could be induced by means of a circulating pump. It is found that the lower limit of inflammability is reduced as the temperature is raised, and is raised slightly by the presence of water vapour. In addition to determinations of the inflammability limits, the pressure developed on explosion has been measured, and this part of the investigation was extended also to include air-methane and air-coal gas mixtures, all at various initial temperatures. For methane, the maximum pressure observed was 66 lb./sq. in. at a mixture containing 9·8% volume of methane. For acetylene, the highest value was 86 lb./sq. in. at about 5·4% by volume. An increase in initial temperature lowers the maximum pressure. Flame speeds were also measured, and were found to increase with increasing initial temperature. J. H. A.

See also Abstracts 2357, 2430, 2466, 2467, 2500.

THERMODYNAMICS.

2496. Transport Phenomena in Einstein-Bose and Fermi-Dirac Gases. Part I. E. A. Uehling and G. E. Uhlenbeck. *Phys. Rev.* **43.** *pp.* **552–561,** *April* **1, 1933.**—The theory of gases in non-stationary states, given by Lorentz and Enskog, is generalised for the quantum statistics to give the hydrodynamical equations and the distribution function in first and second approximation, and formal expressions for the viscosity and heat conductivity coefficients. These results are valid for all statistics and for all degrees of degeneration. Two essential points contribute to this generality: (a) Exact expressions independent of statistics and degeneration can be given for the co-ordinate and time derivatives of the coefficient A of the equilibrium distribution function in terms of the pressure and temperature gradients and time derivatives, though a closed expression for this coefficient as a function of v and T is known only in limiting cases; (b) the function W of the general equation of state for ideal gases in all statistics $pv=(RT/M)W(v^{\frac{2}{3}}T)$ is adiabatically invariant. Numerical values of the viscosity and heat conductivity coefficients, which should come out of the formal theory of the introduction of special assumptions about the molecular forces, have not yet been obtained. It is our hope that these results, when found, may furnish an experimental test of the existence of Einstein-Bose statistics in real gases, as is required by theory. AUTHORS.

2497. Interpretation of Heat in Relativistic Thermodynamics. R. C. Tolman and H. P. Robertson. *Phys. Rev.* **43.** *pp.* 564–568, *April* 1, **1933.**—This article investigates the interpretation of the right-hand side of the relativistic second law of thermodynamics

$$\left(\phi_0\frac{dx^\mu}{ds}\right)_\mu(-g)^{\frac{1}{2}}dx^1dx^2dx^3dx^4 \geqq \frac{dQ_0}{T_0}$$

and shows that the quantity dQ_0 can be interpreted as the heat—measured by a local observer at rest in the fluid at the point of interest—which flows relative to the fluid into an element of the fluid having the instantaneous proper volume dV_0 during the proper time dt_0, where these quantities are chosen so as to satisfy the numerical equality $dV_0dt_0=(-g)^{\frac{1}{2}}dx^1dx^2dx^3dx^4$ and the quantity T_0 is taken as the temperature ascribed to this heat by the local observer. AUTHORS.

2498. Proof of Canonical Distribution within Part of a System. G. Krutkow. *Zeits. f. Physik,* 81. 5–6. *pp.* 377–382, *March* 22, 1933.—A general proof of canonical distribution of the phases within part of a system of many degrees of freedom is advanced. J. S. G. T.

2499. Copper-Magnesium Alloys Examined Thermodynamically. F. H. Jeffery. *Faraday Soc., Trans.* 29. *pp.* 550–553, *April,* **1933.**—The constitution of the copper-magnesium alloys was determined by W. R. D. Jones, and on his results the thermodynamic examination is based. It is found that the constitution of the liquid solution is the simplest possible, consisting of monatomic molecules of copper and magnesium. The constitution of the solid solution of magnesium in copper and that of copper in magnesium are also the simplest possible. The results are shown to be consistent with the existence of the compounds $MgCu_2$ and Mg_2Cu. F. J. B.

2500. Heat Capacity and Entropy of Calcium Oxalate from 19° to 300° Abs. Entropy and Free Energy of Oxalate Ion. W. M. Latimer, P. W. Schutz and J. F. G. Hicks, Jr. *Am. Chem. Soc., J.* 55. *pp.* 971–975, *March,* 1933.—A full range of specific heat data is tabulated, and the entropy of the salt, determined by graphical integration, is 37·28. The free energy of solution is 11791 cal., and the heat of solution, calculated from solubility—temperature coefficient data is 5087 cal. These values give − 22·5 for the entropy of solution, whence the entropy of the calcium and oxalate ions is − 2·12. The calculated entropy of the calcium ion is − 11·4, hence that for the oxalate ion is 9·3. The calculated free energy of the oxalate ion is − 158,000 cal. N. M. B.

2501. Combustion Problem of Internal Ballistics. A. D. Crow and W. E. Grimshaw. *Phil. Mag.* 15, *pp.* 529–553, *March,* 1933. *Nature,* 131. *p.* 805, *June* 3, **1933.**—Expressions have recently been put forward by the authors for the equation of state of a propellant gas [see Abstract 2363 (1931)], and for the rate of burning law for colloidal propellants in terms of kinetic and thermo-dynamic quantities. The present paper deals with the combustion problem in the gun *ab initio* in the light of latest developments. The problem consists in the evaluation of the shot velocity, shot travel and gas pressure at any instant during the motion resulting from the explosive action of propellant of specified chemical composition, grain dimension and charge weight in a gun of known internal configuration. The effects of perturbing factors, such as the influence of the moving column of gas, the spin imparted to the shot by the twist of rifling, friction, wall stress, and resistance of driving band are also taken into account. T. B.

2502. Thermodynamic Properties of Fused Salt Solutions. Part VII. Zinc Bromide in Lead Bromide. E. J. Salstrom. *Am. Chem. Soc., J.* 55. *pp.* 1029–1036, *March*, 1933.—E.M.F. measurements of cells of the type Pb (liquid)/$PbBr_2$ (liquid), $ZnBr_2$(liquid)/Br_2(gas) at $PbBr_2$ molar fractional concentrations between 0·20 and 1·0 and at temperatures between 390° and 520° C. are recorded, together with the calculated activities, activity coefficients, free energies of formation, and partial molal free energies of lead and zinc bromides. The densities of fused $ZnBr_2$ and of 50 % $ZnBr_2$–$PbBr_2$ solutions have been determined over the same temperature interval. The free energy of dilution of $PbBr_2$ shows, unlike the case of $PbCl_2$, positive deviations from Raoult's law, the causes of which are discussed briefly; it is not explicable directly in terms of the volume change which occurs on mixing the two salts. H. F. G.

See also Abstracts 2137, 2214, 2467, 2493.

VAPOUR PRESSURE.

2503. Vapour Pressure of Liquid and Solid Carbon Dioxide. C. H. Meyers and M. S. van Dusen. *Bureau of Standards, J. of Research,* 10. *pp.* 381–412, *March*, 1933.—The vapour pressure of liquid CO_2 from the critical point (31·0° C.) to the triple point (– 56·60° C.) and the vapour pressure of the solid from the triple point to the normal sublimation point (– 78·515° C.) have been measured with an accuracy of 1 or 2 parts in 10,000. Equations have been obtained to represent these data, the average deviations from the equations being 1 part in 10,000 for the liquid and about 2 parts in 10,000 for the solid. The equation for the solid represents also the best work of other laboratories at and below – 78° C. The vapour-pressure equation for the solid has been correlated with calorimetric data from other laboratories. Pressures and relative volumes have been observed along several isotherms in the critical region. A set of tables of the vapour pressure and the rate of change of vapour pressure with temperature calculated from the equations are given. AUTHORS.

See also Abstract 2493.

ACOUSTICS.

2504. Problem Relating to Theory of the Rayleigh Disc. M. Kotani. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 30–57, *Jan.*, 1933. *In English.*—The moment of the fluid pressure acting on a thin circular disc placed obliquely in the field of a plane sound-wave is calculated, taking account of the compressibility and treating a/λ as a finite quantity, a being the radius of the disc and λ the wave-length. A numerical discussion is given and also a mathematical Appendix. G. G. S.

2505. Action of an Air Cushion and Absorbing Wall on a Telephone Membrane. K. Schuster and A. Hohberg. *Ann. d. Physik,* 16. 2. *pp.* 203–216, *Feb.*, 1933.—The authors investigate theoretically the influence of an air cushion with an absorbing wall on a piston membrane and show that under certain limiting conditions the results are applicable, with slight modification, to the case of a stretched membrane. It appears possible to calculate the acoustic absorption coefficient from the reaction on the membrane and the acoustic properties of the boundary wall. Measurements on an electromagnetic telephone show the disturbing influence of the natural tone and damping of the membrane, and such telephones are not suitable for these measurements. E. T. A. R.

2506. Struck String. H. G. Mohamed. *Acad. Sci. U. P., India, Bull.* 2. *pp.* 39–42, *Aug.*, 1932.—An experimental study by the photographic method of the influence of the initial velocity of the hammer upon the tone quality produced in the struck string. For the particular conditions of the experiment, not all given quantitatively, no important change in the tone-quality with change in velocity of the hammer was observed. W. H. Ge.

2507. Struck String. M. Ghosh. *Indian Journ. Phys.* 7. *pp.* 365–382, *Dec.* 1, 1932.—An experimental study by the photographic method, of the variation of the duration of contact for one hard, two elastic and a felt hammer of the same mass, striking a string at different distances from the bridges. As in previously examined cases the duration of the impact is a discontinuous function of the distance of the impact from a bridge. When the impact is at the mid-point it is found that with increase in elasticity the duration of the impact increases to a maximum value, slowly decreases and finally tends to a constant value for the given value of the relative mass of the hammer. The damping of the string is found to have little effect over the range studied. With increase of radius of curvature of a hard hammer striking at the mid-point it was found that the duration of impact first remains constant, then increases to another constant higher value, for the hammer of given relative mass. W. H. Ge.

2508. Sonic Measurement of Rate of Dissociation of Nitrogen Tetroxide. C. E. Teeter, Jr. *J. Chem. Phys.* 1. *pp.* 251–265, *April,* 1933.—It has long been supposed that the rate of dissociation of N_2O_4 could be calculated from observations of the dispersion of sound in the gas. Einstein's equations gave the velocity constant in terms of the dispersion and the properties of the substances, regarded as ideal, acoustically transparent gases. Dispersion has been reported and rate constants calculated by several observers. On the other hand an equal number of negative results have been reported. Recently the theory has been examined critically by D. G. C. Luck [see Abstract 3830 (1932)] and modified to take account of the absorption of sound and the deviations from the gas laws. Moreover dispersion has been observed for nondissociating gases, particularly CO_2. In this gas, time lag in the equilibrium between vibrational and translational-rotational degrees of freedom causes an increase of velocity exactly parallel with that caused by dissociation. Indeed any type of equilibrium in the system may be expected to produce a dispersion of sound in some frequency region related to its own frequency, and it is not possible to distinguish between the types of equilibrium by sound measurements. The use of very small measuring tubes also produces a dispersion of somewhat smaller magnitude. Under these circumstances it is difficult to see how any interpretation can be made or conclusions drawn. In a series of measurements made during the last five years, the author has found no measurable dispersion of sound in N_2O_4 up to 53·8 kc. The velocity of sound at this frequency agreed closely with that determined by Grüneisen and Goens at audible frequencies, although high absorption made observation difficult. At higher frequencies no evidence of transmission could be obtained although sound up to 860 kc. was employed. This increasing absorption shows that a dispersive region is reached but it is not possible to say whether dissociation, time lag, or a combination of both is responsible for the dispersion. This applies equally to the velocity increases found by Richards and Reid [see Abstract 1571 (1933)] in the same frequency region. Hence it seems that the sonic method for measuring rates of dissociation is not likely to fulfil the hopes of its proponents, and further experimental work will not be fruitful. AUTHOR.

2509. Acoustical Properties of Parabolic Reflectors. K. Satô and M. Sasao. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 93. *pp.* 339–356, *Feb.*, 1933. *English Abstract.*—In continuation of experiments described in an earlier paper [see Abstract 5117 (1932)] the authors have investigated the effect of the shape upon the directive properties of parabolic reflectors. Using several reflectors of different shapes (but having the same aperture) the variation of the intensity of the collected sound with the angle between the axis and the direction of a parallel beam of sound has been determined. Intensity measurements were made with a Rayleigh disc. It is found that the directive properties are much more marked for high frequencies than for low, and that, for a given diameter, it is little affected by the shape. For the same frequency there is little difference between the directive properties of a conical horn and a parabolic mirror. The magnification produced by the mirror is much smaller, however.

J. E. R. C.

2510. Action of Ultrasonic Waves on Photographic Plates. N. Marinesco and J. J. Trillat. *Comptes Rendus*, 196. *pp.* 858–860, *March* 20, 1933.—Exposure to such waves of photographic plates or paper in water before development, or in the developer causes increased blackening, and formation of a slight veil even on an unexposed plate. There is also some colloidal dispersion of the sensitised layer. [See Abstract 1674 (1933)].

C. A. S.

2511. Variation of Acoustical Absorption Coefficient of Porous Bodies with the Angle of Incidence and the Frequency. V. Kühl and E. Meyer. *Preuss. Akad. Wiss., Berlin, Ber.* 26. *pp.* 416–435, 1933.—The variation of the acoustical absorption of a porous material as the angle of incidence of the sound is varied is investigated theoretically and experimentally. It is shown that for small porosities the coefficient of absorption should pass through a maximum as the angle of incidence increases. The relation between the acoustical resistance of the material and the coefficient of absorption is also investigated and the theoretical work is extended to include to take account of the finite thickness of the absorbent. The experimental work was performed in the open air by measuring the amount of sound reflected from a large sheet, the frequencies varying from 1000 to 10,000. The angle of incidence of the sound varied from 10° to 75° and strong evidence for the predicted maximum was discovered in the case of certain fibre boards. A substance of high porosity, such as cotton wool, does not show the effect. A special absorbent of which the porosity could be varied between 0·2 and 0·99 was constructed from waved paper and the variation of the angle dependence agreed well with the theoretical predictions. The relation between the measured acoustical resistances and the absorption coefficients also agreed with the theoretical predictions.

J. E. R. C.

2512. Transmission of Sound through Partitions. A. H. Davis. *Phil. Mag.* 15. *pp.* 309–316, *Feb.*, 1933.—The transmission of sound through solid panels as calculated on the basis of a formula of Rayleigh is compared with a number of experimental results. There is agreement for the lighter partitions not only as regards the dependence of the reduction factor on frequency, but also in absolute magnitude. The heavier panels, however, transmit ten times as much sound as the theory would suggest, a possible explanation being the occurrence of drumlike resonance. G. G. S.

2513. Sound Absorption. E. Wintergerst and H. Klupp. *V.D.I.* 77. *pp.* 91–95, *Jan.* 28, 1933.—The sound absorption of various substances was examined by placing test pieces in a tube 10 cm. wide and observing by means of a microphone the greatest and least values of the pressure amplitude. Consequently the addition and subtraction of the sound striking the particular piece tested and reflected by it were obtained. From this the absorption coefficient could be calculated. Stretched materials, freely suspended substances and plates were investigated. A simple method is given for remedying the often very undesirable dependence on frequency of the absorption material. A comparison is given of the commercial prices of absorption materials based on the unit of absorption.

J. J. S.

2514. Null Lines in a Single-Wave Sound Field. P. C. Hermann. *Hochfrequenztechn. u. Elektroakustik*, 41. *pp.* 64–65, *Feb.*, 1933.—It is shown that in single-wave sound fields interference effects may produce lines where the sound pressure completely disappears. This is first deduced theoretically and then shown experimentally. In passing round such null-lines the phase of the received note changes by 360°. This was shown experimentally by means of the frequency jump observed when the receiving microphone was situated near a null-line, the source frequency being varied continuously. A. W.

2515. Range of Sound Intensity in Music. K. W. Wagner. *Preuss. Akad. Wiss., Berlin, Ber.* 25. *pp.* 372–393, 1932.—The sound intensity was measured in terms of the amplitude of the sound pressure, and measurements were made with many kinds of music and also speech and many kinds of noise. The apparatus included a condenser-microphone

with uniform sensitiveness between the frequencies 60 and 10,000, and the sounds were amplified and recorded in the form of pressure-time graphs from which were derived the maximum pressure ($p_{\text{max.}}$), minimum pressure ($p_{\text{min.}}$) and the " dynamic " ($p_{\text{max}}/p_{\text{min.}}$), expressed in microbars. The measurements with music were made chiefly in the studios of the Berlin broadcasting station during the performance of the usual programmes, and instances of the results are as follows : for a 'cello at 3 metres from the microphone, $p_{\text{max.}}$ was $4 \cdot 2\mu$B, $p_{\text{min.}}$ $0 \cdot 05\mu$B, and $D_{\text{max.}}$ 84 ; the organ at 25 metres gave 21μB and $0 \cdot 3\mu$B. G. E. A.

2516. Estimation of Sound Pressure at Aural Limit by Means of Thermophone. E. Waetzmann and W. Geffcken. ***Phys. Zeits.*** **34. *pp.* 234–235, *March* 15, 1933.—Measurements were made of the sound pressures for minimum audibility in both ears of ten persons, for frequencies used ranging from 250 to 2500 p.p.s. The resulting average curve is compared with the curves obtained by other experimenters. The curve now given lies somewhat below those of (*a*) Fletcher and Wegel, (*b*) Kranz, and (*c*) Meyer, but is considerably above that of Wien. The results are briefly discussed with reference to theories of audition. [See also Abstract 1982 (1933).] A. W.**

2517. Acoustic Demonstration Apparatus. E. Waetzmann. ***Phys. Zeits.*** **34. *pp.* 235–236, *March* 15, 1933.—An account is given of apparatus suitable for simultaneous ocular and aural observation of pure tones, noises, combination tones, vowel sounds, etc. The receiving microphone is housed with its amplifier in a separate chamber. Leads from the amplifier are taken to a filter in the demonstration room and thence to a telephone and also a loudspeaker. The telephone diaphragm is provided with an optical lever whose mirror reflects an arc light beam on to a rotating mirror, from which the light is focussed on a large screen. Tuning forks mounted on resonance boxes have been found suitable sources for observation of pure tones, combination tones, etc., while for noises a gramophone may be used near the microphone, or the pick-up may be connected direct to the amplifier. The filter is capable of adjustment over a wide range of frequencies. A. W.**

2518. Improvements in the Operation of the Bells of a Carillon. G. M. Giannini. ***Acoustical Soc. of America, J.*** **4. *pp.* 245–248, *Jan.*, 1933.—The unsatisfactory performance of the bells of a carillon from a musical standpoint is discussed and an improvement is suggested. This is the use of a damping device to permit greater musical possibilities in the playing of carillons. The operation of the electrical apparatus which performs the damping is described. AUTHOR.**

See also **Abstracts 2125, 2347, 2623.**

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2519. Extension of Maxwell's Rule for Analysing Electrical Networks. Y. H. Ku. *Tsing Hua Univ., Sci. Reports,* 1. *pp.* 215–221, *Dec.,* 1932. *In English.*—A mathematical paper in which Maxwell's rule is extended to the solution of branch currents in networks. Alternating e.m.f. or e.m.f. of any time function is used, with d.c. voltage as a special case. J. J. S.

2520. Analogy between Mechanical and Electrical Systems. F. A. Firestone. *Acoustical Soc. of America, J.* 4. *pp.* 249–267, *Jan.,* 1933.—By considering each mass in a linear mechanical system as having two terminals, one fixed in the mass and one fixed to the frame of reference, every linear mechanical system is reduced to a multiplicity of closed mechanical circuits to which force and velocity relations similar to Kirchhoff's laws, may be applied. The conventional mechanical-electrical analogy is derived from the similarity of the equations $v = f/z$ and $I = E/Z$. It is incomplete in the following respects which lead to difficulty in its application. (I) There is a lack of analogy in the use of the words "through" and "across" which indicates a fundamental difference in the nature of the analogous quantities, for instance, force through and e.m.f. across. (II) Mechanical elements in series must be represented by electrical elements in parallel, and *vice versa.* (III) Mechanical impedances in series must be combined as the reciprocal of the sum of the reciprocals while electrical impedances in series are additive. (IV) There is an incompleteness in the mechanical analogues of Kirchhoff's laws. The new analogy is derived from the similarity of the following equations: $v = f\bar{z}$ and $E = IZ$ where $\bar{z}$ is the reciprocal of the mechanical impedance as usually defined. This new analogy is complete in all of the above-mentioned respects in which the old analogy failed. It leads to analogous relations of a simple sort and permits an equivalent electrical circuit to be drawn in an easy intuitive manner. AUTHOR.

CONDUCTION AND DISCHARGE IN GASES.

2521. Moving Striae in Neon. W. J. Oosterkamp. *Physica,* 13*e*. 2. *pp.* 51–60, 1933.—A method of determining the static characteristics of the striae and intervening dark spaces is described. The differences of potential between adjacent points of maximum and minimum potential is 19–20 volts, whilst that between two adjacent striae is only 10 volts. H. F. G.

2522. Discharge in Air at Atmospheric Pressure in a Homogeneous Electric Field. R. Strigel. *Arch. f. Elektrot.* 27. *pp.* 137–143, *Feb.* 14, 1933.—In a previous paper [see Abstract 692 (1933)] it was shown that the discharge delay under given external conditions depends on the work of extracting electrons from the material of the electrode at negative potential. An investigation of the discharge delay was made for the materials Cu, CuO, Ag, Al, electron and wrought-iron for excess potentials up to 220 % of the static breakdown potential, which was of the order of 5 kV. The delay was found to approach an end value with increasing potential which was very different for the different materials, as was also the value of the excess potential at which the end value was reached. This is attributed to the different values of the work of extracting electrons; the smaller this is the greater is the number of electrons emitted in unit time from the kathode and the flashover can therefore develop in a correspondingly shorter time. In the second part of the paper an account is given of an investigation of the variation of the distribution curve of the discharge delay with ageing of the electrodes. A. W.

2523. Theory of Oscillatory Condenser Discharge. J. Thomson. *Phil. Mag.* 15. *pp.* 682–706, *March*, 1933.—In a paper on arc, spark and glow discharge [see Abstract 3878 (1932)], the author has suggested that the initial stage in the break-down of any gaseous dielectric may be regarded as a condenser "spark." The mechanism of the spark is here studied, a kathode-ray oscillograph is introduced into a circuit containing a spark gap and photographs are made of the discharge under various conditions. A theoretical treatment is given which is in accord with the experiments. The results seem to point to the fact that the potential across the spark gap varies exponentially with time. H. M. B.

2524. Absorption of Energy in Ionised Gases. T. V. Ionescu and Irène Mihul. *Comptes Rendus*, 196. *pp.* 682–684, *March* 6, 1933.—Characteristics associated with the absorption of electromagnetic energy by different regions of a discharge in air, N_2, O_2 or H_2 are briefly discussed. J. S. G. T.

2525. Development of Space Charge at a Spark-Gap with Surge Potentials. J. J. Sämmer. *Zeits. f. Physik*, 81. 5–6. *pp.* 383–404, *March* 22, 1933.—Assuming parallel plane electrodes in air at atmospheric pressure and that the mobility of the positive ions is vanishingly small compared with that of the electrons, Townsend's equations are graphically integrated in order to calculate the development of the space charge when a surge potential is applied. The investigation covers the period from the instant of application of the potential up to the time when the first electron reaches the anode. The results obtained are applied to the problem of electrical breakdown when this occurs with a field of 200 to 300 kV/cm. A. W.

2526. Field Distortion at a Plane Spark-Gap Maintained at Constant Potential, due to the Passage of an Ionising Electron Layer. J. J. Sämmer. *Zeits. f. Physik*, 81. 7–8. *pp.* 440–444, *March* 30, 1933.—With certain assumptions, calculation is made of the field distortion at a plane spark-gap maintained at constant potential, due to the passage of an ionising electron layer. The effect is examined for a layer having 1 electron per cm.^{2} and for electrode distances varying from 0·1 to 10 cm. F. C. C.

2527. Temperature Measurement in an A.C. Carbon Arc. E. F. Richter. *Zeits. f. Physik*, 81. 7–8. *pp.* 539–542, *March* 30, 1933.—The temperature of an arc operating on a.c. is determined by the spectrum line reversal method, a tungsten lamp being used as standard. The phase of the a.c. is obtained stroboscopically. The temperature is a minimum when the phase is 180°. At the centre of a Na-saturated arc of 4 amperes the temperature is about 2700° K. The distribution of temperature in the various parts of a 5-ampere arc is also investigated. F. C. C.

2528. Electric Arc between Metal Electrodes. T. Toniszewski and T. Maciejewski. *Acta Physica Polonica*, 2. 1. *pp.* 67–74, 1933. *French Abstract.*—The static characteristics of arcs between metal electrodes of hemispherical or plane shape were studied for all possible combinations of Fe, Cu, Mo, W and brass. Two characteristics were obtained for each pair of metals by changing the direction of the current and values were found for the coefficient of asymmetry $(e_1-e_2)/e_2$, where e_1 is the potential for the upper characteristic and e_2 that for the lower. Graphical methods were used to find the constants α, β, γ and δ in the Ayrton equation for the pairs Cu—Cu, Mo—Mo, W—W. For Cu and W two ranges of current intensity were found having different constants. For Mo, on the other hand, the constants were the same for all current intensities used.

A. W.

2529. Arcs in Air between Metallic Electrodes. H. Dziewulski. *Acta Physica Polonica*, 2. 1. *pp.* 51–58, 1933. *In French.*—Measurements were made of the counter e.m.f. in arcs in air between similar electrodes of W, Ta, Mo, Cu, Ni, Fe in all possible combinations. A study was also made of the dependence of the counter e.m.f. on the nature of the electrodes, the length of the arc, the electrode diameter and the current intensity. The counter e.m.f. was found to depend not at all, or only very little, on the length of the arc, and, within the current limits of 3 to 4 amperes, no variation with current was observed. The counter e.m.f.'s at the kathode and at the anode were found to be constant, both in value and sign, for each of the metals studied, independent of the combination used, provided the arc conditions were the same. The results support the conclusion that the counter e.m.f. is localised in the layer in immediate proximity to the electrode, in agreement with the hypotheses of Duddell, Hagenbach and Wehrli. A. W.

2530. High-Velocity Vapour Stream in the Vacuum Arc. R. C. Mason. *A.I.E.E., Trans.* 52. *pp.* 245–249 ; *Disc.*, 249, *March*, 1933.—The discovery and importance of a high-velocity vapour stream issuing from the kathode region of a vacuum arc led to a summary of the experiments showing the existence of a vapour stream and a review of the theories proposed to account for it. The velocities were determined from : (1) force on the kathode and weight lost by the kathode ; (2) force on a vane in front of the kathode, and weight of kathode material deposited on the vane ; and (3) energy imparted to vane, and weight of material deposited. Methods (1), (2) and (3) on the copper arc gave vapour velocities from 1 to $2 \cdot 5 \times 10^6$ cm./sec., while method (1) on a mercury arc gave an average of $2 \cdot 24 \times 10^6$ cm./sec. Sources of error would not change the above values greatly. Several proposed theories are shown to be inadequate ; the one possible theory (Risch and Lüdi) is based upon the presence of multiply-charged ions which leave the kathode with a high velocity after neutralisation. AUTHOR.

2531. Density Distribution of Unipolar Ionic Currents. W. Deutsch. *Ann. d. Physik*, 16. 5. *pp.* 588–612, *March*, 1933.—The equations of condition for the conduction of unipolar ions may be solved approximately for the general case when the space charge is small if the changes of direction of the field-strengths modified by this space-charge are left out of account. In applying this theory to the following cases a certain integral expression plays a part which may also be interpreted graphically and evaluated. The examples considered are : (1) a thin emitting wire parallel to a plane ; (2) an emitting edge of a half-plane towards a plane ; (3) a point discharge ; and (4) a thin emitting wire between two parallel planes. The values obtained for the current from a point agree with the experimental values obtained by Warburg. H. L. B.

2532. Scattering of Electrons by Ions and the Mobility of Electrons in a Cæsium Discharge. C. Boeckner and F. L. Mohler. *Bureau of Standards, J. of Research,* 10. *pp.* 357–363, *March,* 1933.—The mobilities of electrons in the positive column of a cæsium discharge are derived from measurements of the electrical gradient and the electron temperature and concentration. The value of the cæsium atom cross-section, estimated from the mobilities at small electron concentrations, is $3\cdot3\times10^{-14}\text{cm}^2$ for electron emergies of about 0·33 volt. The cross-section apparently increases linearly with the concentrations of ions in the discharge. The variation is found to be due to the scattering of the electrons by ions. The value of the ion cross-section can be evaluated from the rate of variation ; it is $75\times10^{-14}\text{cm}^2$ for 0·33 = volt electrons. This magnitude can be explained by the electrostatic interaction between the ions and electrons. AUTHORS.

2533. Distribution of Space Charges in the Mercury-Vapour Arc. J. Pawlikowski. *Acta Physica Polonica,* 2. 1. *pp.* 59–66, 1933. *In French.*—A special mercury-vapour arc tube provided with six cylindrical probes was used to study the effects obtained under various conditions. The results confirm those of Kömmnick and Lübke and show that the mean velocity of the electrons is constant and that they form a single group along the entire length of the arc, with the restriction that in the immediate neighbourhood of the kathode there are besides independent groups of electrons whose velocities are much greater and which correspond to the groups of electrons discovered by Langmuir and Wehrli. A. W.

2534. Gradients of the Glow Discharge in Wide Discharge Vessels and in Tubes. The Term "Normal Gradient." A. Güntherschulze and H. Betz. *Zeits. f. Physik,* 81. 5–6. *pp.* 283–296, *March* 22, 1933.—The residual gradient of a gas discharge obtained when carrier losses at the walls are avoided by use of a very wide discharge vessel, the so-called "normal gradient," is in molecular gases dependent on how many electrons per ampere are available at the kathode. Very careful drying of the gas was found to give results for the normal glow discharge considerably lower than the values hitherto obtained. On the other hand, higher gradients were obtained in wide vessels when the kathode was situated within a glass tube projecting into the wide vessel, so that the electrons entered the wide vessel from the tube in reduced numbers, but with correspondingly increased velocities. In this way it is possible to obtain in a wide vessel a luminous positive column whose gradient is the same as that in a narrow tube. If a striated discharge was produced in hydrogen in the tube projecting into the wide discharge vessel, variations of the gradient in the wide vessel were observed of 100 volts or more, depending on the state of the striated discharge in the tube. A. W.

2535. Glow Discharge in Highly Dried Molecular Gases. A. Güntherschulze and F. Keller. *Zeits. f. Physik,* 81. 7–8. *pp.* 528–538, *March* 30, 1933.—With a high degree of dryness through placing P_2O_5 in the discharge vessel itself the following phenomena were observed in molecular gases : (1) With hydrogen there originates a new extraordinarily beautifully coloured form of the glow discharge with purple-red first kathode layer, dark red dark-space, deep red narrow glow-light column, to which adjoins a bright blue zone towards the anode where it fades. Spectrally these colours are produced by four lines of very great intensity which at different distances from the kathode suddenly attain their high intensity. (2) Nitrogen is chemically so active that it combines with all metals except Pt. The current density of the normal kathode fall is only about one-tenth of that measured formerly in ordinary N. With nitride-free Pt the normal kathode fall amounts to only 166 volts. (3) Oxygen is likewise chemically very active. The current density of the normal kathode fall is scarcely one-third of that formerly measured. J. J. S.

2536. Deposits of Metallic Mercury by H.F. Discharge. D. Banerji and R. Ganguli. *Phil. Mag.* 15. *pp.* 676–681, *March,* 1933.—In the h.f. discharge in gases a deposit occurs on the electrodes. This is probably due to mercury from the McLeod gauge, so discharge tubes with side tubes containing mercury are excited by sleeve electrodes and the form and position of the rings formed near the electrodes are photographed and examined. The deposit is proved to be mercury. The electric charge on the mercury particles as they move into position under the discharge is discussed. H. M. B.

2537. Electrodeless Discharges in Argon. Part I. Electrical Properties. S. P. McCallum and L. Klatzow. *Phil. Mag.* 15. *pp.* 829–839, *April,* 1933.—The electrical characteristics, more especially the dependence of the electric force upon pressure, is investigated in the luminous positive column of the electrodeless discharge in argon excited by h.f. oscillations. J. S. G. T.

2538. Ionisation of Water Vapour by Ionic Impact. H. D. Smyth and D. W. Mueller. *Phys. Rev.* 43. *pp.* 116–120, *Jan.* 15, 1933.—By using the apparatus of Smyth and Stueckelberg the authors succeed in confirming and extending the results of other investigators. Two ionisation potentials for H_2O^+ are found, namely at 12·7 and 16·0 volts. Other positive ions in much smaller numbers appear as follows :–H^+ at 18·9, OH^+ at 18·9, H_3O^+ with H_2O^+, O^+ at 18·5, H_2^+ at 33·5, and O_2^+ (very weak). The probable processes of ionisation involved are discussed. Negative ions observed include OH^-, O^- and H^-. Lozier's observations of a critical electron speed for the formation of H^- is confirmed and discussed. H. L. B.

2539. Ionisation of Sulphur Dioxide by Electronic Impact. H. D. Smyth and D. W. Mueller. *Phys. Rev.* 43. *pp.* 121–122, *Jan.* 15, 1933.—By means of a mass-spectrograph it is found that in SO_2 ions of SO_2^+ appear at 13·1 ± 0·3 volts, SO^+ ions at 16·5 ± 0·5 volts and ions of mass 32, either S^+ or O_2^+ appear at 16·0 ± 0·7 and increase sharply at 22·3 ± 1·0. No O^+ ions are observed. The authors discuss the probable processes of formation of these ions. H. L. B.

2540. Silane Formation during Hydrogen Discharge. E. Hiedemann. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 20–32, *March,* 1933.—The formation of a condensable gas (silane) [see Abstract 2826 (1931)] during electrical discharges through hydrogen in quartz vessels shows no fatigue in contrast to that in glass vessels. This difference is explained by the assumption that fatigue in glass vessels is a consequence of the recombination of the sodium atoms of the glass surface. In the presence of mercury, HgH is formed, but practically no silane. The author opines that the so-called proofs of the existence of neutral triatomic hydrogen are invalid. H. H. Ho.

2541. Negatively Charged H Atoms from Light Emission in the Photographic Region. R. Döpel. *Phys. Zeits.* 34. *pp.* 199–200, *March* 1, 1933.—Experimental details are given for investigating whether negatively charged H atoms are found in canal rays. No conclusive evidence was obtained. W. R. A.

2542. Motion of Electrons in Heterogeneous Magnetic Fields. H. Ertel. *Gerlands. Beitr. z. Geophys.* 38. 2. *pp.* 142–146, 1933.—A theoretical method is developed for finding the path of an electron in a magnetic field. Two examples are given to show how the motion can be obtained graphically. In the first example, a homogeneous field is considered and the path is a spiral of constant radius, as is to be expected from earlier considerations. H. M. B.

2543. Paths of Electrons in Axially Symmetric Electric and Magnetic Fields. C. Störmer. *Ann. d. Physik,* 16. 6. *pp.* 685–696, *March,* 1933.—A general mathematical treatment is given for determining the paths of electrons in axially symmetric electric or magnetic fields, also in combined electric and magnetic fields. The results are compared with those obtained by Busch [see Abstract 1099 (1927)]. The case where the magnetic field is derived from a series of co-axial circular currents is next considered, with application to any type of circular coil, and then a graphical construction is developed for the field of force. A. W.

2544. Heterogeneous Chemical Reactions in the Silent Electric Discharge. Parts II, III and IV. S. Miyamoto. *Hiroshima Univ. Journ. Sci.* 3. *pp.* 79–136, *Dec.,* 1932. *In English.*—The apparatus and method were those previously described [see Abstract 337 (1933)]. The reactions of hydrogen with 81 compounds, including oxides, halides, sulphides, sulphates, and nitrates of various metals, are described. Oxides, halides, and sulphides are commonly reduced to metal, and sulphates to sulphides. H. F. G.

2545. Design of an Apparatus for Kathode Sputtering. J. A. Darbyshire. *Journ. Sci. Instruments,* 10. *pp.* 83–85, *March,* 1933.—Details of the construction and operation of an apparatus for the preparation of thin metallic films on glass or on collodion by sputtering are given, also references to previous papers on this subject. AUTHOR.

2546. Circuit for Recording Multiply-Coincident Discharges of Geiger-Müller Counters. T. H. Johnson and J. C. Street. *Frank. Inst., J.* 215. *pp.* 239–246, *March,* 1933.—A self-contained and portable valve circuit is described for use in recording multiply-coincident discharges from three counters. The circuit differs from those previously described in that it uses three stages of amplification before the pulses are combined. Phenomena associated with overvoltage, with capacity effects and with recovery time, are investigated. The probability of good operation is found to be increased and the residual counting rate is lowered and is made less dependent on overvoltage if a small amount of iodine vapour is introduced into the air in the counters. F. C. C.

2547. Probe Measurements in the Sodium Arc. F. H. Newman. *Phil. Mag.* 15. *pp.* 601–610, *March,* 1933.—An introduction deals with previous applications of the probe method for the measurement of space potential, arc gradient, kathode and anode falls, etc., and this method is now used to determine the kathode fall of potential in the sodium arc. The ordinary fine wire probe usually employed was found to be useless with this type of arc, while, owing to mechanical difficulties, it was not possible to use the swinging probe method devised by Nottingham. The best probe was found to be a tungsten rod turned to a diameter of 1 mm. over a length of 10 mm. at one end, which latter was then covered with a thin glass tube and the extremity ground flat. The remaining part of the tungsten rod was 6 mm. diameter, and by means of this device excessive heating of the probe was avoided. Measurements made with it were consistent, and showed no erratic values due to thermionic emission. Full details are included. H. H. Ho.

2548. Practical Methods of Starting the Conduction in Mercury Arcs. L. J. Buttolph and D. W. Dana. *Rev. Sci. Instruments,* 4. *pp.* 206–215, *April,* 1933.—This article reviews the various methods previously used to initiate the discharge in commercial types of gaseous conduction arcs and details a recently developed method with the use of a copper oxide rectifier to supply d.c. for the starting of a.c. arcs. [See also Abstract 626 (1931).] AUTHORS.

See also Abstracts 2298, 2301, 2361, 2602, 2628.

CONDUCTION IN SOLIDS AND LIQUIDS.

2549. Dependence of the Electrical Resistance of Pure Metals on Temperature. E. Grüneisen. *Ann. d. Physik,* 16. 5. *pp.* 530–540, *March,* 1933.—An accurate calculation of the function σ was carried out, σ being $= \rho/\mathrm{T}$, where $\rho =$ specific resistance and $\mathrm{T} =$ absolute temperature. The results are given in tabular form. The resistance formula $\rho = \mathrm{T}\sigma\,[1 + a_1\,\mathrm{T} + a_2\,\mathrm{T}^2]$ which with decreasing T passes into Bloch's T^5 rule, on the other hand through the expression in brackets is adapted also to high temperatures, and satisfies the observations on the metals Li, Na, Cu, Ag, Au, Al, Pb, W, Rh, the better the smaller the residual resistance of the metal test piece is. The characteristic temperature Θ_r obtained from the variation of resistance agrees on the whole well with the value Θ_c deduced from the specific heat. Pt and Pd are not adapted to the new formula. It seems that here the older formula which passes into the T^4 rule is more suitable. J. J. S.

2550. Recovery of the Electrical Resistance of Binary Mixed Crystals of Copper, Silver and Gold from the Consequences of Mechanical Treatment when Cold. G. Tammann and K. L. Dreyer. *Ann. d. Physik,* 16. 6. *pp.* 657–666, *March,* 1933.—Additions to Cu, Ag, and Au which form mixed crystals cause either increase or decrease of the rise of the resistance through mechanical treatment when cold, but always increase the specific resistance. The metals Cu, Ag and Au, which form a natural group of the periodic system in the narrower sense and possess the same lattice, mutually influence each other in a very similar way, and the effects mentioned are comparatively small in amount. An addition of Ni to Cu, both of which possess cubic face-centred lattices and nearly equal atomic radii, causes diminishing of the percentage increase of resistance $\Delta w/w \times 100$ caused by cold manipulation. Whilst the raising of the specific resistance is the greater the further removed the additional metal is from the basic metal in the periodic system, this rule does not hold for the raising of $\Delta w/w \times 100$. The raising of the resistance by cold mechanical treatment is the greater the more different the lattice of the basic and additional metal and the greater the atomic radius of the added metal. The temperatures of the inflection points on the recovery curves of the resistance and of the hardness of Cu, Ag, and Au are in most cases raised by additions forming mixed crystals, and with larger additions of the foreign metal a second inflection point occurs on the recovery curve of the resistance. J. J. S.

2551. Recovery from Mechanical Treatment when Cold in Iron and Nickel. G. Tammann and G. Moritz. *Ann. d. Physik*, 16. 6. *pp.* 667–679, *March*, 1933.—In Fe and Ni the temperature coefficients of the electric resistance of the hard metal are smaller than those of the soft. The temperature of recovery for the hardness in Fe and Ni is considerably higher than that for the electric resistance. The temperature interval of the recovery of resistance in Fe and Ni is not appreciably shifted with the degree of mechanical treatment, that of the recovery of hardness only very little. The potential energy which persists in the metal with mechanical treatment when cold is with Fe first developed in the temperature interval of the abrupt decrease of the hardness, with Ni in two temperature regions, that of the loss of magnetism and that of the decrease of the hardness. The increase of the electric resistance and of the hardness with rising degree of mechanical manipulation proceeds in different ways. The hardness increases most strongly with small degrees of manipulation, the resistance with high. J. J. S.

2552. Recovery of Electrical Resistance and of Hardness of Binary Iron Mixed Crystals from the Consequences of Mechanical Stress when Cold. G. Tammann and V. Caglioti. *Ann. d. Physik*, 16. 6. *pp.* 680–684, *March*, 1933.—In order to study the action of mixed crystal forming additions on the recovery from mechanical stress when cold, alloys of iron with 4 atomic per cent. of various added metals were produced and formed into wires. The characteristic peculiarities of these different alloys are described and their recovery curves given. For iron and the mixed crystals examined, the temperatures of the inflection points on the recovery curves of the resistance, of the temperature coefficients, and of the hardness are given in a table. For each alloy the percentage change of resistance $\Delta w/w \times 100$ produced by mechanical stress when cold is also given. J. J. S.

2553. Compressibilities and Pressure Coefficients of Resistance of Certain Elements, Compounds and Alloys. P. W. Bridgman. *Am. Acad., Proc.* 68. 2. *pp.* 27–93, *March*, 1933.—Experiments on the compressibility and electrical resistance under pressure are made by a method previously described [see Abstract 2543 (1931)] upon the elements Cb, Rh, Ru, Cr, As and Be; on seven miscellaneous compounds, including the metal compound Cu_5Cd_8: and on series of Ag-Au, and Fe-W alloys, including one alloy of Fe, W and Co. Experimental details for preparing crystalline specimens of many of the materials are given. Several of the substances behave in an unusual or anomalous manner. Thus the resistance of Ru varies more with temperature than is usual, and in an abnormal way. The compressibility of Cr which at 30° C. is less than that of Fe, at 40° C. is greater than that of Fe, and the variation of its resistance is an abnormal function of temperature and pressure. Arsenic is anomalous in a direction perpendicular to the axis, in the cleavage plane. In this plane, compressibility is less than that of Fe, while across the plane it is 10 times as high. A single crystal of Be shows large hysteresis effects. The compressibility of Cu_5Cd_8 is a most complicated function of pressure. Alloys exhibit other anomalies. The significance of these abnormalities from the points of view of thermodynamics and of crystalline structure is discussed. J. P. A.

2554. Effect of Pressure on Electrical Resistance of Single Metal Crystals at Low Temperatures. P. W. Bridgman. *Am. Acad., Proc.* 68. 3. *pp.* 95–123, *March,* 1933.—The effects of hydrostatic pressure, usually up to 7000 kg./cm.², and at – 78° and — 183°C., on the electrical resistances of the non-cubic single crystals of Zn, Cd, Sn, Bi, Sb, As, Te, are measured by a method previously employed for crystals of the cubic system. [See Abstract 866 (1933).] The anomalous behaviour of As [see preceding Abstract] continues at low temperatures. Te exhibits very large variations of resistance with temperature and pressure, the resistance at 95° C. and 12,000 kg./cm.² being only 1 % of the resistance at 0° C. and atmospheric pressure; an anomaly which appears not to be connected with crystal structure. In all cases, for every orientation of every metal crystal, the pressure coefficient of resistance at – 183° C. is greater *numerically* than at — 78° C. In Zn, Cd and Sb pressure tends to equalise the resistance in different directions, although to a smaller extent at low temperatures. In Bi and Sn, the differences are accentuated by pressure and low temperature. J. P. A.

2555. Effect of Tension on the Electrical Resistance of Single Antimony Crystals. Mildred Allen. *Phys. Rev.* 43. *pp.* 569–576, *April* 1, 1933.—The adiabatic tension coefficient of resistance of single antimony crystals has been determined for various orientations. Since antimony crystals have the same type of symmetry as bismuth, the curves connecting the coefficient with the primary and secondary orientations have the same general shape as in the case of bismuth and again uphold the theory put forth by Bridgman. The observed values of the coefficients for antimony when the tension and current are parallel to the trigonal axis and perpendicular to it are different both in magnitude and in sign, whereas in the case of bismuth the two were both negative and very nearly equal in magnitude. The six coefficients necessary completely to determine the behaviour of the resistance when deforming forces are applied to the antimony crystals have been found (1) without correcting for strain, and (2) correcting for the changes arising from the strain produced by the tension. [See Abstract 1598 (1933).] AUTHOR.

2556. Conductivity of Oxides and Nitrides at High Temperatures. E. Podszus. *Zeits. f. Elektrochem.* 39. *pp.* 75–81, *Feb.,* 1933.—Attempts to determine the conductivities of the highly insulating oxides MgO, Al_2O_3, CaO, BaO and ThO_2, as well as BN, in a vacuum and in various gases. A considerable decrease of conductivity is brought about by recrystallisation, and also by surrounding the oxide with the gas corresponding to its anion. The conductivity is the lower the greater the energy required for the formation of the oxide. The purer the substance, the more perfectly it can be represented by a single *e* function. E. E. F. d'A.

2557. Change in the Lattice Constant and the Conductivity of Palladium by Charging with Electrolytic Hydrogen. F. Krüger and G. Gehm. *Ann. d. Physik,* 16. 2. *pp.* 174–189, *Feb.,* 1933.—The lattice constant and the resistance of palladium that has been charged electrolytically with hydrogen are measured as functions of the concentration of the hydrogen in the palladium. X-ray photographs and their photometric evaluation show that in the mean interval of concentration between roughly $C_1 = 0{\cdot}03\ \mathrm{H}/\rho_d$ and $C_2 = 0{\cdot}77\ \mathrm{H}/\rho_d$ there are two phases, each of which exhibits a stretched palladium lattice but no new lattice type. The measurements of the resistance lead to the same conclusion regarding the existence of two such phases in the mean interval. These results agree with those of J. O. Linde and E. Borelius in many respects. The present experiments indicate, however, that these two phases correspond to two different saturated solutions of hydrogen in palladium, but not to chemical compounds in definite proportions. H. L. B.

2558. Lattice Constants and Electrical Conductivity of Electrolytically Charged Palladium-Silver Alloys and Their Dependence on the Dissolved Hydrogen. F. Krüger and G. Gehm. *Ann. d. Physik*, 16. 2. *pp.* 190–202, *Feb.*, 1933.—If the percentage of silver in palladium-silver alloys does not exceed about 60–70 % the alloys behave exactly the same as palladium [see preceding Abstract], that is, there are two co-existing phases. It is shown by extrapolation that if the percentage of silver is gradually increased beyond 45 % the two lattice constants of the two phases become more and more nearly equal and the region of concentration in which the two phases co-exist becomes correspondingly narrowed down, until finally only one phase can be present. There has been a certain discrepancy in the values obtained for the solubility of hydrogen in palladium-silver alloys containing varying percentages of silver in that some investigators have found a maximum in the curve and others only a linear decrease. The authors account fully for this discrepancy. H. L. B.

2559. Electrical Resistance of Hydrogen-Charged Palladium Wires. H. Brüning and A. Sieverts. *Zeits. f. phys. Chem.* 163. *Abt.A.* 5–6. *pp.* 409–441, *March*, 1933.—Measurements were made of the electrical resistance of palladium wires in an atmosphere of hydrogen at temperatures between 160° C. and 310° C. and with hydrogen pressures up to 28 atmospheres. Between 160° C. and 200° C. the amount of hydrogen absorption was also determined. Deductions are drawn from the measurements as to the formation of the H–Pd alloys. J. J. S.

2560. Effect of Small Water Additions upon the Conductivity of Electrolytes in Non-Aqueous Solvents. O. L. Hughes and H. Hartley. *Phil. Mag.* 15. *pp.* 610–636, *March*, 1933.—The effect of small water additions upon the conductivity of the following solutions has been measured: Four salts in methyl alcohol; one salt in ethyl alcohol, and eight salts and two acids in acetone. The viscosities of the various mixed solvents employed have been measured, and also the densities of the acetone-water mixtures. The effects produced by these water additions have been found to be proportional to the amount of water added, and on this observation a statistical view of ion solvation has been put forward. AUTHORS.

2561. Conductivity Measurements in Nitro-Compounds. Part III. Behaviour of Electrolytes in Nitro-Compounds. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 163. *Abt.A.* 5–6. *pp.* 321–339, *March*, 1933.—The extrapolation of conductivity measurements in nitro-compounds is reviewed, including the influence on the measurements at the

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higher dilutions by the chemical interaction of the solute and solvent [see Murray-Rust, Hartley and Wright, Abstract 2131 (1931)]. It is shown that the validity of the Debye-Hückel-Onsager equation for strong electrolytes is limited by the dielectric power of the solvent and the magnitude of the ions of the electrolyte. The differentiating action of nitro-compounds is discussed in relation to other media. In solvents for which Walden's rule for the picrates of the tetra-alkylammonium ions does not rigidly hold, approximation to constancy of the product $\lambda_\infty \eta$ is observed as the kation increases in size ; hence, the deviations are probably due to abnormal behaviour of the tetra-alkylammonium ions. On the assumption that the product $l\eta$ has the constant value 0·267 for the picrate ion, calculations are made of the ionic mobilities in nitromethane and nitrobenzene, and from them the solvation numbers are deduced. The relation of these numbers to the properties of the solvent is discussed. T. H. P.

2562. Current and Field Characteristics in Insulating Material with a Single Thin Removable Surface Charge. W. O. Schumann. *Arch. f. Elektrot.* 27. *pp.* 155–168, *March* 15, 1933.—A theoretical investigation is made of the phenomena in a dielectric which possesses a removable thin layer of charged particles. The thinner the dielectric, the more apparent are the effects to be observed. In general the currents through the layer increase exponentially with the time. Reverse currents at short-circuit and reverse potentials after cut-off are dependent on the position of the layer at the instant of short-circuit or of cut-off. With commutation of the applied potential jumps are found in the current curve. With alternating potentials it is possible for unidirectional currents to be obtained. The effective capacity and loss angle are dependent on the frequency and both may vary with time. A. W.

See also Abstracts 2482, 2520, 2593, 2599.

DIELECTRICS AND CAPACITANCE.

2563. Dispersion and Polarisability and the van der Waals Potential in the Alkali Halides. J. E. Mayer. *J. Chem. Phys.* 1. *pp.* 270–279, *April*, 1933.—It is shown that the ultra-violet absorption of NaCl, KCl and KI, which one may estimate from recent experimental work, is in agreement with the dispersion of these salts. With these assumed absorption curves, the dipole-dipole potential constant for the van der Waals attraction between negative ions can be calculated with considerable accuracy. The constants can be estimated for the other alkali halides. The quadripole-dipole constant is also approximated for all alkali halides. The resulting van der Waals potential is much greater than that previously calculated and accounts for the stability of CsCl type lattice for CsCl, CsBr and CsI. The polarisability of a given ion depends on the crystal. It is here assumed that the polarisability varies inversely as the "main frequency" in the crystal. This is shown to be in approximate agreement with experiment. AUTHOR.

2564. Atomic Polarisation. C. P. Smyth. *J. Chem. Phys.* 1. *pp.* 247–250, *April*, 1933.—New values of atomic polarisations are obtained from the temperature variation of the dielectric constants of gases. Although the values are of a greater magnitude than those calculated for simple molecules from infra-red intensity measurements, they show that the improbably high values previously found for several alkyl halides are incorrect. If the molecule is not very large, its atomic polarisation is a relatively small quantity unless dipole rotation may occur within the molecule as indicated by the dielectric constant of the substance in the solid state. [See also Abstract 275 (1930).] AUTHOR.

2565. Influence of Pressure on the Dielectric Constant of Carbon Dioxide up to 1000 Atmospheres between 25° and 150° C. A. Michels and Mrs. C. Michels. *Roy. Soc., Phil. Trans.* 231. *pp.* 409–434, *March* 13, 1933.—The measurements were made at a frequency of 508 kilocycles using the heterodyne beat method [see also Abstract 4476 (1932)], and results are given for pressures from 30 to 1000 atmospheres at 25°, 30°, 31°, 32°, 40°, 50°, 75°, 100°, 125°, 140°, 145° and 150° C. Where possible the value for the Clausius-Mossotti expression has been calculated, and is found to be independent of temperature, and to show a tendency to decrease with increasing pressure. A detailed description is given of the high-pressure apparatus, the electrical circuit, and thermostatic and other devices used. H. H. Ho.

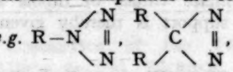
2566. Dielectric Polarisation. Parts VI and VII. E. C. E. Hunter and J. R. Partington. *Chem. Soc. J. pp.* 309–313, *March*, 1933. —This paper continues previous work [see Abstract 1178 (1933)]. Part VI deals with benzene solutions of ethyl ($\mu \times 10^{18} = 1 \cdot 5$) and benzyl (0·4) hyponitrites and *s*-methyl sulphite (2·9); nitroamine (3·75) in dioxan; and the parachors of methyl (266·5), ethyl (343·5), and benzyl (421·5) hyponitrites. Part VII contains the data for the dipole moments in benzene of nitromethane (3·02), nitroethane (3·19) and nitro-*n*-butane (3·29). The results show that appreciable induction occurs in the hydrocarbon chain, the effect of the nitro-group extending at least as far as the third carbon atom, whilst the moment of the nitro-group is distinctly smaller in the aliphatic than in the aromatic series. H. H. Ho.

2567. Induction Between Bond Moments in Halogenated Methanes. C. P. Smyth and K. B. McAlpine. *J. Chem. Phys.* 1 *pp.* 190–196, *March*, 1933.—The dipole moments of four fluorochloromethanes are measured in the vapour state. The inductive effects of carbon-halogen bond moments are calculated and, through these, the moments of methyl fluoride and methyl chloride are used to calculate approximate values for CH_2Cl_2, $CHCl_3$, and $CFCl_3$, which are in satisfactory agreement with the observed values. The moments of these molecules are then used to calculate values for other substituted methanes which are in excellent agreement with the observed values. The value of a bond moment is treated as a function of its environment. AUTHORS.

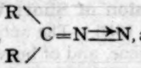
2568. Dipole Moments and Structures of Long-Chain Molecules. C. P. Smyth and W. S. Walls. *J. Chem. Phys.* 1. *pp.* 200–204, *March*, 1933.—The dipole moment of isoprene is measured and found to differ so little from zero that it cannot play a part in the tendency of the substance to polymerise. The moments of hexamethylene and nonamethylene bromide are determined and that of trimethylene bromide is redetermined. Consideration of these values with those previously measured for other long-chain dibromides indicates that the moment of trimethylene bromide may be increased by the existence of a van der Waals attractive force between the two bromine atoms. The orienting effect of the two C — Br dipoles upon one another becomes negligibly small when the carbon chain between them is lengthened from six to nine atoms. The results are best explained by the supposition that the carbon chain is an extended zigzag structure which is not infrequently bent by rotation around one or more C — C bonds.

AUTHORS.

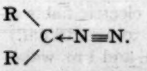
2569. Dipole Moments and Structures of Organic Azides and Aliphatic Diazo-Compounds. N. V. Sidgwick, L. E. Sutton and W. Thomas. *Chem. Soc., J. pp.* 406–412, *April*, 1933.—The following dielectric constants have been measured: In benzene solution: phenyl azide ($\mu = 1\cdot55 \times 10^{-18}$ e.s.u.), p-chloro-phenyl azide (0·33), p-tolylazide (1·96); in CCl_4 solution: diphenyldiazomethane (1·42), di-p-tolyldiazomethane (1·96), di-p-chlorophenyldiazomethane (0·62), phenylisocyanate (2·23), and p-chlorophenylisocyanate (0·84). In every case the tolyl compound has a larger and the p-chlorophenyl compound a smaller moment than the phenyl compound, showing that the negative end of the dipole in the last is directed away from the benzene nucleus. With the azides the moment is very nearly the algebraic difference of those of the monosubstitution products. It is shown that the dipole moments of the azides and the aliphatic diazo-compounds are compatible only with either the ring structures, *e.g.*



, or resonance between the two linear structures, *e.g.* $\mathrm{R{-}N{=}N\overset{\rightarrow}{=}N}$,



and $\mathrm{R{-}N{\leftarrow}N{\equiv}N}$,



The heat data, however, are incompatible with the ring structure, and give a value intermediate between the two linear structures, which themselves differ by an amount surprisingly large for resonance to occur.

H. H. Ho.

2570. Dipole Moments of Benzene Derivatives with Freely Rotatable Substituents. J. W. Williams. Comments by H. L. Donle. *Zeits. f. phys. Chem.* 20. *Abt. B.* 3–4. *pp.* 175–183, *March*, 1933.—This paper is in response to a criticism by Donle and Gehrckens [see Abstract 5145 (1932)] as to the accuracy of his data, and contains a comparison with their results. The agreement of the author's earlier values with those of Donle and Gehrckens is fairly good, but in the cases of p-chlorophenol and p-bromophenol there seems to be insufficient data on which to make a decision as to validity. Donle discusses at length the last-named cases and submits that his experimental method has the advantage over that employed by Williams by its independence from the great variations of the dispersion in the visible region of the spectrum and also by elimination of other defects.

H. H. Ho.

2571. Electric Moments of Stannic Chloride and Some of its Derivatives. M. E. Spaght, F. Hein and H. Pauling. *Phys. Zeits.* 34. *pp.* 212–214, *March* 1, 1933.—The dielectric constants of carbon tetrachloride solutions of stannic chloride, tin tetraethyl, diethyl-tin-dichloride, and triethyl-tin-chloride and bromide were measured at 25° C. and from these data and refractivity data the electric moments of the substances were evaluated. Stannic chloride and tin tetraethyl both have a zero moment, whilst the diethyl substituted chloride has a moment of $3\cdot85 \times 10^{-18}$ e.s.u. and the triethyl substituted chloride one of $3\cdot44 \times 10^{-18}$ e.s.u. It is therefore concluded that stannic chloride and tin tetraethyl both have a symmetrical tetrahedral structure. W. R. A.

2572. Dipole Moments of Certain Benzene Derivatives. H. Poltz. *Zeits. f. phys. Chem.* 20. *Abt. B.* 5–6. *pp.* 351–356, *April*, 1933.—The following dipole moments ($\mu \times 10^{-18}$) are given: nitrobenzene (3·93), o-nitrotoluene (3·66), m-nitrotoluene (4·14), p-nitrotoluene (4·42), o-iodotoluene (1·21), m-iodotoluene (1·57), p-iodotoluene (1·71), o-nitroiodobenzene (3·92), m-nitroiodobenzene (3·43), and p-nitroiodobenzene (3·04). These data are briefly discussed. H. H. Ho.

2573. Dielectric Constants of Solutions of Amino Acids and Peptides. Dipole Moments of Esters of Amino Acids and Peptides. J. Wyman, Jr., and T. L. McMeekin. *Am. Chem. Soc., J.* 55. *pp.* 908–922, *March*, 1933.—Measurement of the dielectric constants of α, β, μ and ϵ amino acids and of five peptides of glycine in aqueous solution afford additional evidence in favour of the zwitter ion hypothesis. These molecules have a rod-like structure without any tendency to bending or to ring formation. Approximate values of dipole moments have been obtained and additional support is thereby given to the zwitter ion hypothesis. W. R. A.

2574. Dispersion of Short Waves. R. Luthi. *Helv. Phys. Acta*, 6. 2. *pp.* 139–159, 1933.—The anomalous dispersion of the dielectric constants of nitrobenzene, and of butyl and amyl alcohols has been studied in very dilute solutions in a mineral oil of high viscosity for electric fields of frequency between 0 and $1 \cdot 7 \times 10^9$ (wave-lengths between ∞ and 18 cm.). Two partial dispersions have been identified at about 100 m. and 1 m. wave-length, and attributed to polar molecules surrounded by molecules of oil and to polar molecules associated within the solution respectively. These phenomena are adequately discussed and fit in with Debye's theory. The alcohols appear to exhibit a third region of anomalous dispersion in the very short wave-lengths. H. H. Ho.

2575. Dielectric Losses in Rock-Salt. P. L. Bayley. *Phys. Rev.* 43. *pp.* 355–357, *March* 1, 1933.—The phase angle of pure dry rock-salt, measured through the range of 1 to 1000 kc., is found to be less than 0·0001. Moisture increases the power factor greatly, especially at the lower frequencies. Traces of surface contamination with certain organic substances may cause rock-salt to have marked apparent dipole properties. The power factor is not measurably affected by prolonged exposure to either intense X-rays or kathode rays. AUTHOR.

2576. Electrical Breakdown of Liquids by Means of the Electro-Optical Shutter. H. W. Washburn. *Phys. Rev.* 4. *pp.* 29–37, *Jan.*, 1933.—The static and the impulse breakdown of paraffin oil and xylol were investigated by means of the electro-optical shutter. To obtain satisfactory operation of the shutter it was found necessary to use a double shutter consisting of three crossed nicol prisms and two Kerr cells. Because of the liquids being only commercially pure and of the occluded air and moisture, several types of sparks were observed for a given method of applying the voltage. For the early stages of static breakdown, however, the ionisation was usually more intense at the anode. With impulse breakdown in paraffin oil there was observed no increase in uniformity of type of breakdown as compared to static breakdown. With xylol, on the other hand, a fair degree of uniformity in type was observed. This uniformity was due to the extremely short time of voltage application, thus causing a decrease in the secondary effects resulting from impurities and occluded gases. AUTHOR.

2577. Electric Moment as a Measure of the Ionic Nature of Covalent Bonds. J. G. Malone. *J. Chem. Phys.* 1. *pp.* 197–199, *March*, 1933.—The two-electron bond with hydrogen is found to have the following values of $\mu \times 10^{18}$: H—As 0·10; H—P 0·36; H—I 0·38; H—S 0·63; H—Br 0·78; H—Cl 1·03; H—N 1·04; H—O 1·32. These values are believed to give the positions of the elements on an electronegativity scale which is shown to be similar to that prepared by Pauling [see Abstract 5336 (1932)]. The reported moments for inorganic halides as well as the unpublished measurements of A. L. Ferguson and M. G. Malone, giving $\mu = 3 \cdot 1 \times 10^{-18}$ for $SbCl_3$ and $\mu = 2 \cdot 4 \times 10^{-18}$ for $SbBr_3$, give fair agreement in most cases with those calculated from the above scale. On the basis of calculated values appreciable moments are predicted for all trihalides of the fifth-group elements except PI_3 and NCl_3 which should give close to a zero moment. AUTHOR.

2578. Standard Capacities of the Physikalisch-Technische Reichsanstalt. E. Giebe and G. Zickner. *Zeits. f. Instrumentenk.* 53. *pp.* 1–12, *Jan.*; 49–56, *Feb., and pp.* 97–108, *March*, 1933. *From the Reichsanstalt.*—The author deals first with the historical development of the various standards referring to the type, capacity value and difficulties in use. The properties desired in a standard condenser are (1) capacity independent of its surroundings; (2) angular loss small and within the limits of measurement; (3) for air condensers solid insulators are essential to avoid dielectric losses, and must be of the best quality: quartz is best in this way if free from strain and noticeable impurities; (4) high stability of structure to avoid temporary variations of capacity, and (5) construction such that parallel connections are simple. A comprehensive description is given of various Reichsanstalt standards based on a lengthy experience of their use. For solid or rotating condensers, with capacities of four ranges, each is described and illustrated and the procedure for adjustment to the desired value explained. To measure very small capacities and their angular losses, for short electrical wave-lengths and for the resonance frequency of piezoelectric resonators, variable capacities of very small steps are used with the smallest possible initial value. In this connection three types are described, one of which is without initial capacity. The procedure followed for absolute and relative methods and for values of partial capacities is explained in detail. Finally, the properties of condensers such as secular change, and the influences of insulating materials, humidity and temperature of the atmosphere and tension in the material, are discussed. R. S. R.

2579. Electric Moments by the Molecular-Ray Method. I. Estermann and M. Wohlwill. *Zeits. f. phys. Chem.*, 20. *Abt. B.* 3–4. *pp.* 195–208, *March*, 1933.—Previous work [see Abstract 2588 (1929)] is extended in two directions. The dipole moments of a number of organic molecules are studied by the former method, and a new method of measuring the intensity of molecular rays is developed by the help of which dipole moments may be calculated from the deviation of molecular rays in electric fields. W. R. A.

See also Abstracts 2479, 2562.

ELECTROCHEMISTRY.

2580. Temperature Coefficient of Cu-Hg Cell. (Miss) M. Quintin. *Comptes Rendus*, 196. *pp.* 538–540, *Feb.* 20, 1933.—Gives tables of the e.m.f. of the copper-, copper sulphate-, mercury sulphate-mercury cell at various temperatures and concentrations [see Abstract 2032 (1932)]. At a concentration of 0·525 gm.-mol. per litre of cupric sulphate the fall of e.m.f. per degree is $3 \cdot 85 \times 10^{-4}$ volt. This value becomes zero at a concentration of 0·00525, and increases in the opposite direction on further dilution. E. E. F. d'A.

2581. Temperature Coefficient of the Saturated Weston Cell. P. Vigoureux and S. Watts. *Phys. Soc., Proc.* 45. *pp.* 172–178; *Disc.*, 178–179, *March* 1, 1933.—The effect of temperature on the e.m.f. and on the performance of acid Weston cells has been studied from − 24° to + 40° C. The e.m.f. reached a maximum at about 3°, and at − 20° it was just over a millivolt less than the maximum. The cells behaved satisfactorily at − 16°, but at − 18° freezing took place gradually and was accompanied by a rapid decrease in e.m.f. At − 24° the electrolyte had completely solidified, and the e.m.f. was about 12 mV lower than the maximum. The frozen cells resumed their normal behaviour when kept at room-temperature for about a day. Cooling increased the internal resistance of the cells. The e.m.f. temperature formula in common use does not hold below 0°, but a slightly different formula has been obtained, valid between − 20° and + 40°. AUTHORS.

2582. Rôle of Finely-Divided Mercury in the Depolariser of the Standard Cell. R. B. Elliott and G. A. Hulett. *J. Phys. Chem.* 37. *pp.* 271–277, *March*, 1933.—The importance of the ratio of Hg(ous) : Hg(ic) and its influence on the e.m.f. of the cell is discussed. The observed tendency of cells built with finely divided mercury to increase in e.m.f. is considered to be in keeping with theory. The small globules of mercury tend to become greater, owing to the "distilling over" to larger ones of less free energy. As the process continues the importance of mercury in the reaction $Hg^{++} + Hg = Hg_2^{++}$ becomes less and the e.m.f. rises to its normal value. F. J. B.

2583. Application of the Theory of Debye [Formula of Gronwall, La Mer and Sandved] to Solutions of Cupric Sulphate. (Miss) M. Quintin. *Comptes Rendus*, 196. *pp.* 767–769, *March* 13, 1933.—Application of this extension of the Debye-Hückel theory [see Abstract 2871 (1928)] to the cell Cu(amalgam 2 phases) $CuSO_4$, (*c*) Hg_2SO_4(sol.) Hg gives a constant value for the atomic radius only for concentrations less than 0·01*N* approximately. This is probably due to the radii being different for the two ions. C. A. S.

2584. Combustible Material Cells. E. Baur and J. Tobler. *Zeits f. Elektrochem.* 39. *pp.* 169–180, *March*, 1933.—The paper is a compilation of the various form of cells in which combustible materials are employed. The various types of cell, carbon, hydrogen, sulphurous acid, etc., are classified and summarised. The patents covering the various applications of this type of cell are recorded. F. J. B.

2585. Electrochemical Behaviour of Palladium. Part I. Deposition of Palladium and of Palladium-Silver Alloys from Complex Salt Solutions. G. Grube and D. Beischer. *Zeits. f. Elektrochem*, 39. *pp.* 131–139, *March*, 1933.—Palladium and silver may be deposited from a cyanide or thiocyanate bath containing the corresponding potassium salt, but the yield is poor and the deposit is greyish-black and but little adherent to the base. Electrolysis of a potassium palladium cyanide bath produces a deposit of metal, but the current yield is of the order of only 1 %; at a mercury kathode reduction products, *viz.*, univalent palladium compounds, are formed. A solution containing silver (0·1*M*) and potassium (2*N*) thiocyanates yields on electrolysis at room-temperature a silver deposit of similar colour and crystal size to those obtained from cyanide solutions, but with a lower current density (0·3–0·5 ampere/dm^2). The deposits obtained from potassium palladium thiocyanate solutions are dark in colour and contain much organic matter, together with sulphide and basic thiocyanate. A coherent deposit of silver or of silver-palladium alloy cannot be obtained from an ammoniacal solution of silver nitrite. The introduction of ammonia into the complex dinitritodiammine palladium with formation of tetrammine-palladium nitrite, has been demonstrated by conductivity measurements. H. F. G.

2586. Electrolysis of Fused Alkali Cyanides. M. Centnerszwer and J. Szper. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9*a*. *pp.* 267–270, *Oct.–Nov.*, 1932.—A current yield of cyanogen of 80 % may be obtained by the electrolysis of fused sodium cyanide with a nickel anode, but the anode dissolves in the melt. Aluminium and graphite electrodes, with which current yields of 90 and 85 % respectively are obtained, are satisfactory, except that with aluminium the anode voltage oscillates periodically between 2·4 and 3 volts. The cyanogen may be passed into a solution of sodium hydroxide and carbonate and the process thus rendered continuous. H. F. G.

2587. Theory of Discharge of Different Species of Ions. O. Essin. *Zeits. f. phys. Chem.* 164. *Abt. A.* 1–2. *pp.* 87–96, *March*, 1933.—By means of the principle of Förster and Jorre it is shown that the current in an electrolyte containing different ions is distributed between them in the proportion of their relative mobilities. Equations are developed for the current distribution between different species of ions in the same solution. They are employed to explain the regularities observed in the joint discharge of zinc, zinc-copper ions, mercurous and mercuric ions, and for the electrolytic formation of ammonium and sodium persulphate. F. J. B.

2588. Nernst Theory of the Association of Strong Electrolytes. J. Zirkler. *Zeits. f. phys. Chem.* 164. *Abt. A.* 1–2. *pp.* 134–137, *March*, 1933.—The mean heats of dissociation of ammonium and caesium nitrates are calculated and compared with the true degree of association, determined from the conductivity and partly from the latest osmotic measurements [see Abstract 1181 (1933)]. The electrical forces between the ions are also considered. T. H. P.

2589. Interchange Between Metallic Atoms and More Noble Ions. Determination of the Absolute Surface of Metals and of the Active Surface of Noble Metals. O. Erbacher. *Zeits. f. phys. Chem.* 163. *Abt. A.* 3–4. *pp.* 196–239, *Feb.*, 1933.—Details are given of the quantitative measurement of the deposition of tungsten on nickel, platinum, and lead, of polonium on platinum, gold, and silver, of lead on platinum, gold on silver, and platinum on silver, from solutions of various free acid contents. Two distinct cases exist: in one, local elements produced by (*a*) partial exchange of the metals and (*b*) variations of activity at different points of the surface, are effective and lead to visible deposition of the more noble metal; in the second case simple exchange alone occurs, and leads to formation of a monatomic film. The distinction arises from the fact that in the second case the local e.m.f.s are lower than the decomposition potential required for deposition of the noble metal. Under suitable conditions, which are discussed in detail, cases of the second type may be employed to determine the active surface of a metal. The surface, *e.g.*, of Ni, is found to be 2·5 times greater than the measured area after rubbing with fine or coarse emery, and 1·7 times greater after polishing with Vienna chalk. When hydrogen is adsorbed on a platinum surface, only that at the active points is replaceable by nobler ions with the formation of a monatomic layer; application of this principle shows the active surface of platinum which has been rubbed with emery to be more than twice the measured surface, *i.e.*, about 85 % of the total surface; after polishing, the active surface is very small (0·2–0·03 of the measured surface), and after platinising it is some 17 times greater than the measured surface. H. F. G.

2590. Ionisation of Sulphuric Acid. H. M. Dawson. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 359–364, *Jan.*, 1933.—The difficulties of interpreting the ionisation stages of sulphuric acid, having regard to interionic forces, is discussed. The evaluation of the constants in the equation for the catalytic effect of the acid in the hydrolysis of ethyl acetate is described; hence, with the help of reaction velocity data, the value 0·01 is obtained for the thermodynamic ionisation constant of the second ionisation stage. Reliable values for the H-ion concentration, concentration of the bisulphate and of the sulphate ion and the degree of second stage ionisation are tabulated for an acid concentration range of 0·001–0·1 mol. per litre. N. M. B.

2591. Limiting Laws of the Interionic Attraction Theory of Strong Electrolytes. P. van Rysselberghe. *J. Chem. Phys.* 1. *pp.* 205–209, *March*, 1933.—The various methods of obtaining the limiting laws of strong electrolytes are briefly discussed. It is shown that the dependence of these limiting laws on the temperature, the dielectric constant of the solvent and the volume of the solution can be deduced from the Gibbs-Helmholtz equation and the virial theorem of Clausius. The Debye-Hückel and the Kramers limiting laws are found to be of the same type as these general limiting laws, with numerical coefficients obtained thanks to the use of the Poisson equation. AUTHOR.

2592. Boundary Layer of Dilute Electrolytes and the Diffusion Potential. Shu-Tsu Chang. *Ann. d. Physik*, 16. 5. *pp.* 513–529, *March*, 1933.—The change with time of the diffusion potential was investigated in the case of various dilute solutions of KCl and LiCl forming electrolyte combinations with normal HCl solution. After disturbance of the boundary layer Planck's stationary condition was again obtained. The separate ionic concentrations or ionic contents of the boundary layer are calculated. The period of time in which the diffusion process is accomplished is much longer than that for the transition from the stationary condition to the mixture condition. In all cases investigated the results could be explained by Planck's theory. Occasionally in practice the simpler Henderson formula can be used with sufficient accuracy. J. J. S.

2593. Properties of Electrolytic Solutions. Part III. Dissociation Constant. R. M. Fuoss and C. A. Kraus. *Am. Chem. Soc., J.* 55. *pp.* 1019–1028, *March*, 1933.—Comparison of the observed conductance data with the Bjerrum ion-pair model for the undissociated molecules in solution showed that the physical picture agreed well with the data. The dissociation constant of a binary electrolyte is shown to be a function of the dielectric constant of the solvent, and can be calculated from the parameter. [For Part II see Abstract 2010 (1933)]. F. J. B.

2594. Transport Numbers in Mixed Aqueous Solutions of Alkali Chlorides. Part I. P. van Rysselberghe. *Am. Chem. Soc., J.* 55. *pp.* 990–996, *March,* 1933.—The transport numbers of mixtures of alkali chlorides are interpreted by aid of the hypothesis that " the mobilities of the various ions are proportional to their values in solutions of the two salts alone of the same concentration as the total concentration of the mixture." The MacInnes formula for the transport number of one of the two positive ions in a mixture of alkali chlorides is shown to be a direct consequence of this hypothesis. F. J. B.

2595. Transport Numbers in Mixed Aqueous Solutions of Alkali Chlorides. Part II. P. van Rysselberghe and L. Nutting. *Am. Chem. Soc., J.* 55. *pp.* 996–1001, *March,* 1933.—The fundamental hypothesis developed in the previous paper [see preceding Abstract] and the MacInnes formula derived from it are used to account for the transport numbers of the potassium, rubidium, and cæsium ions in mixtures of their chlorides with large amounts of sodium chloride, and for the transport numbers of the potassium ion in mixtures of its chloride with large amounts of lithium chloride. F. J. B.

2596. Hydrogen-Oxygen Cells. J. Tobler. *Zeits. f. Elektrochem.* 39. *pp.* 148–167, *March,* 1933.—A series of determinations of the potentials and potential-current curves of electrodes made of granular carbon, activated graphite, and of wire electrodes of different metals. Air was tried as a depolarising agent. It was found that carbon-metal electrodes in time lost their power of activating oxygen. The hydrogen electrodes were investigated in normal solutions of sodium hydrate, and the electrodes consisted of nickel, nickel and platinum, iron, iron and platinum, platinised graphite and platinised platinum. Platinised graphite electrodes showed at 0·1 volt polarisation current densities up to 0·7 ampere per sq. dm. F. J. B.

2597. Stirring and Grain Electrodes. E. Baur. *Zeits. f. Elektrochem.* 39. *pp.* 168–169, *March,* 1933.—A reply to the paper by J. Tobler on the air electrode with carbon grains [see preceding Abstract]. Exception is taken to the statements and explanations of the behaviour of these two types of electrodes given in the paper. F. J. B.

2598. Hydrogen Overvoltage and Structure of the Double Layer. A. Frumkin. *Zeits. f. phys. Chem.* 164. *Abt.A.* 1–2. *pp.* 121–133, *March,* 1933.—Consideration of the distribution of potential in the double layer according to the hydrogen overvoltage theory [see Erdey-Gruz and Volmer, Abstract 1059 (1931)] leads to the following relation between separation potential ϕ, current i and electrokinetic ζ-potential :

$$\phi + \zeta = \frac{2RT}{F} \log [H\cdot] - \frac{2RT}{F} \log i + \text{const.}$$

If Heyrovsky's theory is taken as basis in place of that of Erdey-Gruz and Volmer, the factor $\frac{2RT}{F}$ before log i must be replaced by $\frac{RT}{F}$. This equation, which becomes $\phi + \zeta = \text{const.}$ when [H·] and i are constant, admits of the calculation of electrokinetic potential from polarisation measurements.

Such calculations are made from the experimental data of Herasymenko and Slendyk [see Abstract 4155 (1930)] on the influence of neutral salts on hydrogen overvoltage, and the results are compared with the values of the ζ-potential derived from Stern's theory of the double layer. T. H. P.

2599. Practical Valve Circuit for the Measurement of E.M.F. S. B. Ellis and S. J. Kiehl. *Rev. Sci. Instruments*, 4. *pp.* 131–137, *March*, 1933.—A sensitive and accurate method is described for measuring e.m.f.s. through large resistances, up to around 100,000 megohms, or for measuring e.m.f.s. in systems which are easily polarised. The measuring instrument is simply and inexpensively constructed of standard parts which are readily available, and in actual use it is convenient, dependable and rugged. AUTHORS.

See also Abstracts 2159, 2350, 2491, 2502, 2561.

ELECTRONS AND PROTONS.

2600. Determination of e/m for an Electron by a New Deflection Method. F. G. Dunnington. *Phys. Rev.* 43. *pp.* 404–416, *March* 15, 1933.—The results, though not considered final, are given of a new measurement of e/m which is being made. The essential points of the method are: acceleration of electrons to a continuous range of velocities by a radiofrequency electrostatic field, choice of a particular velocity by magnetic field resolution, measurement of this velocity through radiofrequency fields applied to a pair of accelerating slits and a pair of decelerating slits. No acceleration voltage need be measured and errors due to contact potentials are practically eliminated. The value obtained from two groups of observations made at different electron velocities (the corresponding electron voltages being about 1420 and 844 volts) is $e/m_0 = (1 \cdot 7571 \pm 0 \cdot 0015) \times 10^7$ e.m.u. A comparison of six recent and probably most reliable e/m determinations is made. The weighted average of these is $e/m_0 = (1 \cdot 7598 \pm 0 \cdot 0005) \times 10^7$ e.m.u. J. J. S.

2601. Determination of e/m by Means of Photoelectrons Excited by X-Rays. G. G. Kretschmar. *Phys. Rev.* 43. *pp.* 418–423, *March* 15, 1933.—A value of e/m has been obtained by a magnetic deflection method by making use of X-ray photoelectrons and the magnetic spectrograph. Electrons were ejected from thin evaporated or sputtered films of gold, silver, copper and platinum by the X-radiation from a molybdenum target metal tube placed close to the film and working at an input of 1·5 kw. The velocity of ejection of the photoelectrons was computed from the difference between the energies associated with Mo K radiation and the various absorption limits of the metal films. Relativity corrections were made since these velocities correspond to from 8000 to 15,000 equivalent volts. The a_1 and a_2 components of the Mo $K\alpha$ line were clearly resolved since the magnetic field was kept very constant by the use of a potentiometer and continuous hand control. The weighted mean value of e/m_0 obtained from five plates is $1 \cdot 7570 \pm 0 \cdot 0026 \times 10^7$ e.m.u. per gm. This result is based upon a value of $h/e = 1 \cdot 3737 \pm 0 \cdot 0005 \times 10^{-17}$ as taken from X-ray crystal measurements. By taking h/e from X-ray data the resulting value of e/m is independent of the uncertainty involved in the crystal grating constant. AUTHOR.

2602. Some Factors Affecting Cross-Section for Collisions of the Second Kind between Atoms and Ions. O. S. Duffendack and K. Thomson. *Phys. Rev.* 43. *pp.* 106–111, *Jan.* 15, 1933.—The collisions of the second kind here referred to are those between ions and normal atoms, in which the ion returns to a normal atom and the normal atom is ionised or ionised and excited. This involves the transference of an electron as well as of energy. The enhancing of spark lines of Ag, Au, Al and Cu is considered. Experiments are described in which the relative probability of the excitation of terms in the spark spectra of these metals by impacts of the second kind (as above defined) with ions of helium and neon are determined as a function of the resonance discrepancy. The results show a definite resonance effect, but an empirical formula has not yet been obtained. The experiments indicate that besides resonance discrepancy, the type of level being excited is an important factor in determining the probability of excitation. H. L. B.

2603. Elastic Scattering of Electrons by Mercury Atoms. E. B. Jordan and R. B. Brode. *Phys. Rev.* 43. *pp.* 112–115, *Jan.* 15, 1933.—The angular distribution of electrons elastically scattered by single mercury atoms is determined for electrons of 10 to 800 volts energy and in an angular range of 5° to 172°. The values of the atomic scattering coefficient P_θ (the number of electrons scattered per atom, per unit electron current density, per unit solid angle at an angle θ to the original beam) are computed from the observed scattering currents. New maxima are found in the angular range between 120° and 172°. Practically all the curves indicate that the value of P_θ rises to a relatively large maximum at or near 180°. H. L. B.

2604. Reflection and Secondary Radiation of Protons in Collisions with Solid Bodies. C. Ramsauer and R. Kollath. *Ann. d. Physik*, 16. 5. *pp.* 560–569, *March*, 1933.—An apparatus is described in which protons of velocities ranging from 30 to 1500 volts impinge on solid surfaces of brass and lamp-black; the number of reflected protons and ejected secondary electrons is measured. These numbers are found to increase with increasing velocity of the impinging protons and are considerably greater in the case of brass than in that of lamp black. The number of reflected protons is markedly smaller than the number of ejected secondary electrons. The application of the present method to the reflection and secondary radiation of *electrons* gives satisfactory agreement with the earlier results of Gehrts. H. L. B.

2605. Scattering of Slow Protons by Gas Molecules. C. Ramsauer and R. Kollath. *Ann. d. Physik*, 16. 5. *pp.* 570–587, *March*, 1933.—By means of the 11-zone-apparatus [see Abstract 2556 (1932)] the scattering of slow protons by molecules of He, A, H_2, CH_4 is determined for angles ranging from 15° to 167°; the velocities of the protons lie between 30 and 120 volts. The retarding potential curves in helium and argon show clearly that there are two distinctly separate groups of captured particles, one of low-volt velocity and the other of high-volt velocity. In methane only the slow particles are found to occur; in hydrogen, if the scattering angle is fairly large, the results resemble those of methane, but at the smaller scattering angles there is an appreciable percentage of faster particles. A comparison of the velocities of the fast particles, as found experimentally for the different angles of scattering, with the velocities calculated on the assumption that the collisions occur between elastic spheres of masses which bear a definite ratio to one another shows perfect agreement in the calculated and the experimentally determined values. Hence the group of fast particles always consists of elastically scattered protons, even if their velocity is appreciably smaller than the primary velocity. The curves giving the angular distribution of the elastically scattered protons are given for helium and argon. The authors infer from their curves that by far the greater number of collisions between protons and helium atoms lead to elastic scattering of the protons.

H. L. B.

2606. Stopping Power of Atoms with Several Electrons. F. Bloch. *Zeits. f. Physik*, 81. 5–6. *pp.* 363–376, *March* 22, 1933.—The stopping power of more complicated atoms for swiftly moving charged particles is calculated by the Thomas-Fermi method. Good agreement with experiment is obtained, the stopping power varying in a simple manner with the number of electrons. G. G. S.

See also Abstracts 2108, 2333, 2337, 2338, 2382, 2383, 2532.

ELECTROSTATICS.

2607. Switch for Electrometer. F. Bayer. *Zeits. f. Instrumententk.* 53. *pp.* 131–133, *March*, 1933.—Description of a new "universal" switch for Thomson or Dolezalek electrometers. A. D.

See also Abstract 2207.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2608. Change of Resistance of Bi Single Crystals in Magnetic Fields. (New Phenomena). O. Stierstadt. *Phys. Rev.* 43. *pp.* 577–579, *April*, 1933.—The present investigation records the results obtained with a specially constructed crystal goniometer to investigate the conductivity of a metal crystal in any and every configuration of current, field and crystal axes. There is a fundamental difference between the resistance changes of a single crystal and a polycrystal in a magnetic field. In the latter the change of resistance is greatest when the direction of the current is at right angles to the magnetic field and is least when parallel or antiparallel to the field. The present work shows that this is not always the case for single crystals, and measurements on polycrystals are therefore not generally capable of elucidating the laws of magnetic resistance change in metals. It is shown that most of the important crystal planes influence the resistance change in some characteristic fashion, and this is true for all planes which are essential for the description of the elementary cell of Bi lattice. Direct electric or magnetic measurements do not discriminate these planes, and the magnetic change of resistance may be regarded as a means of crystal analysis which is very sensitive for detecting structure of elements which have not been identified optically. S. G. B.

See also Abstracts 2619, 2629.

MAGNETISM AND ELECTROMAGNETISM.

2609. Interpretation of Weiss's Law. H. Fahlenbrach and E. Vogt. *Phys. Zeits.* 34. *pp.* 204–207, *March* 1, 1933.—The author puts forward two arguments against Gorter's conclusion that the magnetic moment of the ions depends on the temperature. If the character of the complex changes with temperature, and thereby causes a change of magnetic moment, the $1/\chi$ and T graph should be curved and not straight. Also the author's observed values giving the dependence of the moment on the concentration are in agreement with the views of Stoner and van Vleck.

According to the latter, the nature of θ is two-fold, and the author proceeds to show that θ and C can be related by an equation of the form: $\theta = -aC + b$, and that with constant C, θ depends on the concentration. In the second paper it is pointed out that the views developed by Fahlenbrach to explain his experimental results introduce a certain difficulty, with regard to the free ions in dilute solutions, which may be avoided by adopting van Vleck's view that the tendency of the ionic value in dilute solutions towards the Hund value does not indicate that the ions are free, but that they are in a perfectly symmetrical electrical field. [See Abstracts 5265–5267 (1932).] G. E. A.

2610. Variational Principles of Electromagnetism. H. Bateman. *Phys. Rev.* 43. *pp.* 481–484, *March* 15, 1933.—The familiar relation between the potentials in electromagnetic theory is regarded as a consequence of the principles of angular momentum and centre of mass expressed by the symmetry of the stress-energy tensor. The electromagnetic equations are derived from a Lagrangian function L equal to an arbitrary function of the invariants $E^2 - H^2$ and $E \cdot H$ of the electromagnetic field and rules different from that of Schrödinger are given for the construction of a stress-energy tensor. AUTHOR.

2611. Interatomic Distances and Ferromagnetism. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 391–396, *April*, 1933. —In ferromagnetic metals and alloys the magnetic moment, at least at temperatures not too near the Curie point, is almost entirely due to electron spin. Heisenberg has shown that the essential requirement is that the interaction integral which occurs in the ordinary quantum mechanical theory of molecule formation should be positive. The present note quotes further evidence which may be regarded as supporting the view that the sign of the interaction integral is a function of the interatomic distance or alternatively as receiving theoretical interpretation in terms of it. A rough calculation is made of the relative interaction energy associated with ferromagnetism of pairs of electrons in neighbouring atoms in Fe, Co and Ni. Manganese is the only non-ferromagnetic element which produces an increased average atomic moment when added to nickel and it is also the only non-ferromagnetic element which gives with Ni an R value higher than for iron. The evidence supports the view that the R value is an important factor in determining the sign and magnitude of the interaction integral. The results indicate that the interaction is a maximum for R values between those of Co and Ni. S. G. B.

2612. Calculation of the Permeability and Hysteresis Loss in Ferromagnetic Laminæ by Suitable Frequencies. W. Arkadiew. *Phys. Zeits. d. Sowjetunion*, 3. 1. *pp.* 1–28, 1933. *In German.*—The formulæ and the curves are given for the calculation of the effective permeability and the energy absorption in an alternating field where ferromagnetic thin plates are installed. The complex permeability values of the material of which the laminæ are made can be determined individually from a pair of conjugate values, and in the case where one of the values of this quantity can be disregarded a value for the apparent permeability of the system is deduced. The range of this value shows it to have a minimum value in every case. For small thicknesses of the plates this value becomes infinitely great. The formulæ and curves derived can easily be employed to solve other problems of an allied character. S. G. B.

2613. Extensions of the Theory of Magnetisation Curves of Ferromagnetic Single Crystals. R. Gans and E. Czerlinsky. *Ann. d. Physik,* 16. 6. *pp.* 625–635, *March,* 1933.—Theoretical magnetisation curves for single crystals of Co, Ni and Fe in various crystal directions, were derived in an earlier paper, the anisotropy constants being chosen to give best agreement with the experimental values. These constants can, however, be obtained independently from saturation measurements which are available, and adopting this method the magnetisation curves are derived and compared with the observational curves. The agreement is satisfactory and provides support for the Heisenberg ferromagnetic theory. W. S. S.

2614. Rôle of Electron Path Impulses in Ferromagnetic Lattices. H. Ludloff and G. Reymann. *Phys. Zeits.* 34. *pp.* 233–234, *March* 15, 1933.—The results of the Einstein and de Haas effects for ferromagnetics show that the relationship of the magnetic to the mechanical moment of the elementary magnet gives values which depart from that of $g=2$ by a considerable amount, *e.g.*, for Pyrothin $g=0\cdot 5$. The present work considers the energy distribution in a ferromagnetic lattice where the atom has not only a spin but also a path impulse imposed upon it. This is done by means of a model described in the text. It is shown that in general the path impulse disappears in the lattice structure and if so the value becomes $g=2$. By means of a spin in a known coupling dependent upon the type of lattice structure, a disturbance of the initial symmetry about the $\epsilon=0$ axis can be effected and a difference which is not zero due to path impulse results, from which, in consequence, a divergence of the value of g ensues. S. G. B.

2615. Diamagnetic Susceptibility of Helium. F. J. Wiśniewski. *Acta Physica Polonica,* 2. 1. *pp.* 23–29, 1933. *In French.*—The principles of generalised mechanics are applied in the case of a neutral atom of helium on the Bohr model to calculate the susceptibility, the field vector being taken normal to the plane of motion of the electrons. The value calculated agrees well with that found by experiment, viz., $\chi_d=-1\cdot 874\ 10^{-6}$. [See Abstract 1936 (1924).] G. E. A.

2616. Magnecrystallic Action. Part I. Diamagnetics. K. S. Krishnan, B. C. Guha and S. Banerjee. *Roy. Soc., Phil. Trans.* 231. *pp.* 235–262, *Jan.* 31, 1933.—The paper records measurements of the magnetic anisotropy of single crystals of inorganic and organic compounds by a vibration method. The change of susceptibility of certain crystals on melting is also measured, and the magnetic constants of organic crystals are then discussed in relation to the orientations of the molecules in their unit cells. It is concluded that, in favourable cases, it is possible from magnecrystallic measurements to determine the precise orientations of the molecules in the unit cell. Even in complicated cases the magnetic data throw considerable light on the question, and the magnetic method promises to be a useful supplement to X-ray methods. G. E. A.

2617. Paramagnetic Constant of Metallic Rhenium. N. Perakis and L. Capatos. *Comptes Rendus,* 196. *pp.* 611–612, *Feb.* 27, 1933.—In consequence of its position between tungsten and osmium in the Mendeléeff table, and the fact that Honda has found the coefficients of magnetisation of these two elements invariable over a large range of temperature, it is suggested that in accordance with the value for the specific susceptibility of metallic rhenium recently found by Albrecht and

Wedekind, namely $0 \cdot 046 \times 10^{-6}$ at 18° C., then the paramagnetism of rhenium at this temperature should be almost equal to that of osmium. The present work studies the paramagnetism of rhenium as a function of the temperature. In the range from $-79°$ to $+20°$ C., over 98° interval, rhenium possesses a paramagnetism independent of the temperature, giving a value per gm. atom of $X = 68 \cdot 7 \times 10^{-6}$, which is greater than that of tungsten and many times that of osmium. The present results are in complete disagreement with those of Albrecht and Wedekind, the value now given for the coefficient of magnetisation being about eight times that of these observers. The question of impurities in the rhenium sample is discussed and it is shown that even if manganese was present the present result would be valid. S. G. B.

2618. Magnetic Susceptibilities of Lead, Silver and Their Alloys. C. G. Montgomery and W. H. Ross. *Phys. Rev.* 43. *pp.* 358–360, *March* 1, 1933.—The magnetic susceptibilities of lead, silver and their alloys have been determined by a modified Curie balance. They may be expressed by $10^9 X = (116 \cdot 44 \pm 0 \cdot 68) + (0 \cdot 764 \pm 0 \cdot 012)P$, P being the weight per cent of silver. The anomalous results reported previously by Spencer and John [see Abstract 193 (1928)] in regard to the magnetic behaviour of these alloys are not confirmed. AUTHORS.

2619. Thermal and Magnetic Behaviour of Gadolinium Sulphate in the Temperature Range of Liquid Helium. N. Kürti. *Zeits. f. phys. Chem.* 20. *Abt. B.* 3–4. *pp.* 305–324, *March,* 1933.—An apparatus is described for the measurement of the specific heat and the magnetocaloric effect of substances of which only very small quantities are available within the range of temperatures given by liquid helium and liquid hydrogen. In the case of gadolinium sulphate the magnetocaloric effect was measured at these temperatures when the test sample was submitted to a field-strength of 10,000 gauss, and from the results were deduced the nature of the effects upon paramagnetic substances in general. The entropy of magnetisation measured from the magnetocaloric effect coincides with that calculated from the relationship of temperature to the susceptibility. The specific heat of gadolinium sulphate was determined between the temperatures of 1·6° and 20° Abs. Below 7° the specific heat showed a departure from the values given by the proportionality to the cube of the temperature (T^3), which is valid for higher temperatures. At 4° a sharp rise in value occurs so that at 1·6 the specific heat is five hundred times greater than the value extrapolated from proportionality to the T^3 rule. To explain this anomaly it is hypothesised that the fundamental condition of gadolinium ions corresponds to eight orientations of the magnetic moments spaced in eight energetically equidistant terms, the energy difference between two such terms being $0 \cdot 5_2$ cal., or in wave numbers it may be expressed as $0 \cdot 1_8$ cm.$^{-1}$ Thus the values correspond to the requirements of Nernst heat equation for crystal combinations. In a constant field of 1800 gauss the Langevin theory of dependence of specific heat of paramagnetic substances upon magnetisation was investigated. The results were in agreement with those theoretically required. The anomaly is also discussed in relation to the Debye-Giauque work on cold phenomena. S. G. B.

2620. Crystalline Fields of Pr, Nd and Yb from Paramagnetic Susceptibilities. W. G. Penney. *Phys. Rev.* 43. *pp.* 485–490, *March* 15, 1933.—Calculations are made on the temperature variation of the paramagnetic susceptibilities of various salts of the rare earth group, employing the ideas of the crystal field developed in previous papers [see Abstract 1213 (1933)]. It is shown that good agreement can be obtained with the experimental results on the salts $Pr_2(SO_4)_3$, Nd_2O_3 and Yb_2O_3, if the crystalline field is assumed to have the form $\Sigma_i\{Ax_i^2 + By_i^2 - (A + B)z_i^2\}$. This type of field, however, allows no agreement to be had for the experimental data on $Pr_2(SO_4)_3 \cdot 8H_2O$; instead for the octahydrated sulphates, the assumption of a field of cubic symmetry $D\Sigma_i(x_i^4 + y_i^4 + z_i^4)$ is necessary. The various crystalline fields necessary to account for the magnetic data are in good accord with the few facts known on the crystal structure of the different compounds. AUTHOR.

2621. Theory of Diamagnetism for Mono- and Poly-Nuclear Systems. D. P. Ray-Chaudhuri. *Phil. Mag.* 15. *pp.* 797–807, *April*, 1933.—Theories of diamagnetism, due to Hartree, Pauling, Slater, Thomas and Fermi and others are critically reviewed, and an expression for the diamagnetic susceptibility, $-X_{AB}$, of a molecule is suggested in the form, $-X_{AB} = -X_A - X_B + \lambda$, where X_A and X_B refer to the susceptibilities of constituent atoms, and λ is a term dependent upon conditions of molecule formation. J. S. G. T.

2622. Diamagnetism of Free Electrons. J. S. Mitchell. *Phil. Mag.* 15. *pp.* 807–810, *April*, 1933.—Fowler's statistical method is applied to derive an expression for the diamagnetic susceptibility of a gas of free electrons. The value obtained corresponds with Landau's result and shows that, to a first approximation, the diamagnetic susceptibility of a gas of free electrons is one-third of Pauli's value for the paramagnetic susceptibility due to spin. J. S. G. T.

2623. Theory of the Diamagnetism of Conduction Electrons. Part II. Strong Magnetic Fields. R. Peierls. *Zeits. f. Physik*, 81. 3–4. *pp.* 186–194, *March* 11, 1933.—The calculation of diamagnetism is extended to the case of strong fields [see Abstract 2063 (1933)] and the anomalies which occur at low temperatures are compared with those observed in the case of bismuth. The number of the conduction electrons in Bi must be very small and the energy curve which indicates their motion must be very steep in the neighbourhood of its minimum.

J. J. S.

2624. Magnetic Moments of K and Li with Regard to their Nuclear Magnetic Moment. Part II. W. Meissner and H. Scheffers. *Phys. Zeits.* 34. *pp.* 245–252, *March* 15, 1933. *From the Reichsanstalt.*—The points which require to be taken into account in accurate measurements of magnetic moment by the Stern-Gerlach method are considered fully in this second paper [see Abstract 1642 (1933)], and the separate series of measurements are given in full. It is shown, theoretically and by experiment, that in an exact application of Rabi's method, measurements of the inhomogeneity of the field are also necessary, and that the resulting moments are not quite so accurate as those given by the first method. G. E. A.

2625. C.G.S. Magnetic Units. A. E. Kennelly. *Terr. Mag.* 37. *pp.* 447–453, *Dec.*, 1932. *Nat. Acad. Sci., Proc.* 19. *pp.* 144–149, *Jan.*, 1933.—An unofficial summary is given of the actions concerning C.G.S. magnetic units taken by the Symbols, Units and Nomenclatures Commission of the International Union of Pure and Applied

Physics at its Paris Conference in July, 1932, together with a brief outline of the history of these units since 1893, leading up to that conference, as well as a few deductions therefrom. J. J. S.

2626. Nature of Electrodynamic Forces. G. Eibenschütz. *Accad. Lincei, Atti,* 17. *pp.* 161–165, *Jan.* 22, 1933.—Taking as basis the relativity theory of electrons (Coulomb's law of force for stationary charges, Lorentz's force on a moving charge, restricted principle of relativity), the author examines how electrodynamic forces can be derived. He considers the force between two parallel current elements as the net effect of attractions or repulsions between the moving electrons and the compensatory positive charges in the two elements. If $v_1^2v_2^2/c^4$ can be neglected compared with v_1v_2/c^2, where v_1 and v_2 are the velocities of the electrons in the current elements, then the classical law of force between current-carrying elements is obtained. W. S. S.

2627. New Relations in Electromagnetism and their Interpretation. F. Prunier. *R.G.E.* 33. *pp.* 267–278, *March* 4, 1933.—By applying relativistic ideas to the Maxwell equations of the field of a charge in rectilinear motion, the author seeks to show that there are additional equations to which the electromagnetic field must conform. These new relations coincide with those deduced by the author from the hypothesis of an ether. [See Abstract 745 (1931).] W. S. S.

2628. Control of Ignition-Coil Discharge Characteristics. G. I. Finch and R. W. Sutton. *Phys. Soc., Proc.* 45. *pp.* 288–306, *March* 1, 1933.—The theory of the ignition coil is developed and is verified by means of the kathode-ray oscillograph. It is known that the secondary discharge consists of two parts, the "capacity" component due to the discharge, upon breakdown of the spark gap, of the energy stored in the secondary capacity, and the subsequent discharge of the electromagnetically stored energy, the so-called "inductance" component. It is shown that the spark-gap voltage is constant throughout the life of the inductance component, and that the inductance-component current is oscillatory, but unidirectional. The theory leads to the conclusion, confirmed experimentally, that the closing of the primary circuit during the life of the inductance component rapidly extinguishes the secondary discharge. A contact-breaker enabling the duration of opening of the primary circuit to be controlled with accuracy over a range between 0 and 4 msec. is described. The elimination of various portions of an ignition-coil discharge without material effect upon the remainder of the discharge is discussed. AUTHORS.

2629. Change in Magnetic Induction of Fe-Ni Alloys Due to Cold Working and Recovery therefrom by Heating. G. Tammann and H. J. Rocha. *Ann. d. Physik,* 16. 7. *pp.* 861–864, *April,* 1933.—The paper records the results of the determination of the alteration of the magnetic induction of iron, nickel and their alloys in a constant field by drawing a wire whilst cold so as to create a cross-sectional alteration of 96 %, and the subsequent recovery by heating. As typical of the results obtained the decrease of the magnetic induction for irreversible nickel steel under the above conditions is set out as below :—

Nickel (%)	0	2	5	15
Alteration (%)	72	82	19	−45

S. G. B.

2630. Magnetostriction of Ferromagnetic Crystals. R. Gans and J. v. Harlem. *Ann. d. Physik*, 16. 2. *pp*. 162–173, *Feb*., 1933.—The change of length of single crystals of iron and nickel in a magnetic field can be treated according to the same principles as have been used by the authors in dealing with changes in resistance. The problem has been discussed for the case of saturation by Akulov and for non-saturated crystals by Heisenberg. But the assumption which results from the principle of symmetry is only a first approximation ; the authors therefore reconsider the problem, particularly as regards the transverse effects, which cannot be taken over directly from the previous formulæ owing to the different manner in which the experiments have been arranged. It is found that the same *h*-combinations as result from the saturation measurements are decisive for the magnetostriction in the unsaturated state, so that it is possible to predict the phenomena in the unsaturated state and to compare it with the results of experiment. Heisenberg's hypothesis is found to give as satisfactory results as can be expected. H. L. B.

2631. Electrical and Magnetic Measurements. G. Keinath. *Physik*, 1. 1. *pp*. 21–40, 1933.—The author gives a comprehensive survey of the modern apparatus and methods which are available for magnetic and electrical measurements. The extension of these methods to mechanical measurements is also described. J. E. R. C.

2632. Magnetic Balance for the Inspection of Austenitic Steel. R. L. Sanford. *Bureau of Standards, J. of Research*, 10. *pp*. 321–326, *March*, 1933.—The paper describes an experimental model of a magnetic balance for measuring the attractive force between a permanent magnet and a specimen of austenitic steel with which it is in contact. Experiments with this model indicate that such an instrument should be of considerable practical value for the inspection of corrosion-resistant austenitic steel in view of the fact that the magnetic permeability has been found to be a good index of the resistance to corrosion of this type of material. The instrument is portable and can be applied to different parts of a completed structure. AUTHOR.

2633. Measurement of Small Electrodynamic Forces with the Condenser Microphone. A. Agricola. *Hochfrequenztechn. u. Elektroakustik*, 41. *pp*. 30–33, *Jan*., 1933.—A detailed account is given of the standardisation of a condenser microphone for the measurement of small pressures. The forces are referred to the measurable homogeneous magnetic field of a plate-shaped conductor in which the condenser microphone is inserted. The measured forces were between the limits of 0·5 and 120 mg. on the pressure area of 24 cm^2. A. W.

2634. Damping and Resonance with an Einthoven String Galvanometer. A. H. Bebb. *Journ. Sci. Instruments*, 10. *pp*. 75–83, *March*, 1933.—This paper gives the theory of conditions necessary to maintain the Einthoven string galvanometer in the critical condition with and without inductance in circuit. Records are given showing agreement with theory, and a comparison between these circuits when the field strength only is varied. Also, when a sinusoidal electromotive force is applied, the conditions under which the string resonates is considered, and graphs are plotted showing amplitudes against impressed frequencies; these also show fair agreement with theory. In a non-inductive circuit, resonance is not possible when the string is in the critical condition, but the presence of inductance modifies the conditions considerably. AUTHOR.

See also Abstracts 2218, 2520, 2662.

V. 19

MEDICAL RADIOLOGY AND ELECTROLOGY.

2635. E.M.F.s Developed in the Human Subject When in Contact with Metallic Conductors. F. Vlès, Anna Grossman and Madeleine Gex. *Comptes Rendus*, 196. *pp*. 965–967, *March* 27, 1933.—The authors have previously shown the existence of an e.m.f. which is developed when infant patients are placed in contact with a metallic conductor, the degree of which varies, but is related to the atmospheric conductance. The present experiments are to show its existence in adult subjects, experiments being carried out upon four adults, details of the electrodes being given. When the electrodes are first placed in contact with the skin, a period of more or less duration is necessary before a stable value of potential is reached, which appears to vary with age. The actual origin of this potential is complex, but appears to have relationship to the basal metabolism. B. J. L.

2636. Intensities of Visible and Ultra-Violet Radiation in Sunlight. W. Kunerth and R. D. Miller. *Am. Illum. Eng. Soc., Trans.* 28. *pp*. 347–353, *April*, 1933.—Data are presented covering the experimental determination of variations of the visible and of the ultra-violet in sunlight and in skylight, from which a comparison is afforded of the intensities received at various hours of the day and on various days of the year. AUTHORS.

2637. Operation of Thick-Walled X-Ray Tubes on Rectified Potentials. L. S. Taylor and C. F. Stoneburner. *Bureau of Standards, J. of Research*, 10. *pp*. 233–247, *Feb*., 1933.—It is found that thick-walled glass, deep-therapy X-ray tubes do not reach a steady state within the first few minutes of operation on some types of generator. All thin-walled tubes tried thus far quickly reach a steady operation state. Depending upon the mode of control of the generator, the X-ray emission of a thick tube may increase or decrease by 10 to 20 % on mechanical or valve tube rectifiers and not reach a steady state until some 10 min. after starting. The change in X-ray emission between the second and tenth min. of operation appears to depend upon the electrical regulation of the transformer. Cooling of the tube walls with strong air blasts delays the attainment of the steady state, but does not affect the magnitude of the net change in emission. For some generators the output remains steady if the effective tube current and voltage be maintained constant. A qualitative explanation of the effect is based on the blocking action of the high negative charge on the glass walls when the tube is cold. As the tube warms up this charge is dissipated through the increased electrical conductivity of the glass. The influence of the effect upon dosage measurements is discussed. The effect is absent when the tube is operated on nearly constant potential. AUTHORS.

2638. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Distribution of Radiation in a Water Phantom. G. Failla, E. H. Quimby, L. D. Marinelli and J. E. Rose. *Am. J. of Roentgenology and Radium Therapy*, 29. *pp*. 293–307; *Disc*., 362–367, *March*, 1933.—Recently an X-ray apparatus, capable of operation at 700 kV, has been installed in the Memorial Hospital, New York, and a series of investigations, of which the present paper is the first report, have been carried out to compare the effects of such radiation with those obtained by X-ray apparatus operated at 200 kV and the γ-rays of radium. This particular paper deals with the distribution of radiation, as measured in the usual manner by means of a water phantom, the apparatus and general experimental arrangements being described in detail. Small spherical ionisation chambers were used, having celluloid walls of different thicknesses, as well as ionisation chambers having walls of aluminium, copper and lead. It is found that the material of the chamber wall and its thickness, influences the measurement of depth dose values, as determined for water. In order to express depth doses in terms of Röntgen units, no wall effect should be present, and, as regards the absence of this effect, the small celluloid ionisation chambers meet requirements to the greatest extent. It has been so far impossible to make proper comparison between such a small ionisation chamber and a standard air chamber for 700-kV X-rays and γ-rays, and therefore, at present, it should not be assumed that a small chamber can be calibrated to read correctly from 200-kV X-rays to γ-rays. The relative depth doses at a depth of 10 cm., obtained under comparable conditions with 200-kV X-rays, 700-kV X-rays and γ-rays are respectively 29·0, 41·2 and 57·6%. According to this view 700-kV X-rays are better than 200-kV X-rays, but not so good as γ-rays. Owing to the fact that the high cost of radium prohibits its application for therapeutic radiation at distances from the patient, as utilised in X-ray therapy, the advantages of the greater penetration of γ-rays is not fully attained in practice. For example, if a radium pack is applied at a distance of 15 cm. the dose at 10 cm. depth is approximately the same as that delivered by 200-kV X-rays, via 0·5 mm. copper, at a target-skin distance of 50 cm. and a field of irradiation of 400 sq. cm. Depth doses for the radium pack have been determined for distances within the practical range of 6 to 20 cm. and the influence of the size of field irradiated, in relation to depth dose, has been determined for both 200 and 700-kV X-rays. B. J. L.

2639. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Comparison Based on Effects on Iodides, Eder's Solution, and Photographic Film. H. Q. Woodard, E. H. Quimby, and H. R. Downes. *Am. J. of Roentgenology and Radium Therapy*, 29. *pp.* 308–325; *Disc.*, 362–367, *March*, 1933.—A paper, chiefly of experimental data and experimental curves, respecting the varying effect of 200-kV X-rays, 700-kV X-rays and γ-rays upon solutions of potassium and lithium iodide and Eder's solution (precipitation of mercurous chloride). The more penetrating radiations, *i.e.*, 700-kV X-rays and γ-rays, like the lower voltage X-ray radiation, also affects these particular solutions. In the case of the iodides, the liberation of iodine can be estimated quantitatively by its action upon starch solution, as a basis of measurement of the radiation dosage. The effect upon Eder's solution can be determined by a simple titration method. Both methods give reproducible results, allowing co-relation of the three sources of radiation. To make direct comparison the intensity of the ordinary X-rays (at 165 to 200 kV) which can be expressed in *r* per min., are related to "equivalent Röntgens" for the more penetrating radiation. The results so expressed are compared with analogous results obtained by the method of intensity measurement utilising the darkening of a photographic emulsion. From the comparison it appears that the *apparent* radiation at 700 kV and from the radium pack varies with the chemicals and reactions used to measure the intensity, so that the relative effectiveness of the three varying sources depends on these factors. B. J. L.

2640. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Comparison Based on Effects on Drosophila Eggs and on Wheat Seedlings. P. S. and C. T. Henshaw, and D. S. Francis. *Am. J. of Roentgenology and Radium Therapy*, **29.** *pp.* **326–333**; *Disc.*, **362–367**, *March*, **1933.**—The biological effectiveness of 165-kV X-rays, 700 kV X-rays and γ-rays, has been compared in wheat seedlings and Drosophila eggs. There is a differential effect, but the results obtained are so various, that definite conclusions cannot be drawn from the investigators. With this restriction, under conditions which are detailed, it was found that 700 kV X-rays and γ-rays were 1·30 and 1·37 times as effective as 200 kV X-rays for Drosophila eggs and as 1·29 and 1·04 for wheat seedlings. B. J. L.

2641. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Comparisons Based on Biological Changes Produced in Mammalian Tissues with 200 kV X-Rays and γ-Rays. H. J. Bagg and C. R. Halter. *Am. J. of Roentgenology and Radium Therapy*, **29.** *pp.* **334–342**; *Disc.*, **362–367**, *March*, **1933.**—Experiments are described comparing the action of 200 kV X-rays and γ-rays upon mammalian tissues, in the forms of the tails of young mice and ears of adult rabbits. The biological changes studied varied from slight epilation to necrosis of the tissues and, in the case of the mice, a large number of animals were used such as to allow fairly correct quantitative results. The X-ray dosage was measured in *r* and the γ-ray dosage in "equivalent röntgens." After equivalence it is found that the emission of 1 gm. of radium is approximately equivalent to 100 *r* per min. at distance 1 cm. A 4-gm. radium pack at 6 cm. under similar conditions would have an approximate emission of 10 equivalent röntgens. B. J. L.

2642. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Comparison Based on the Production of Erythema in Human Skin. J. J. Duffy, R. F. McNattin, M. M. Copeland and E. H. Quimby. *Am. J. of Roentgenology and Radium Therapy*, **29.** *pp.* **343–345**; *Disc.*, **362–367**, *March*, **1933.**—The physical *r* unit makes no reference to the biological effect. In therapeutic procedures the normal tissues, *via* which radiation is administered to a deep seated tumour, limits the amount of radiation which can be administered. The skin is the first biological structure to show the destructive processes and can therefore be utilised as a biological indicator. The erythema (or redness) of the skin so produced is discussed, and the threshold erythema is defined and the mode of its experimental determination described. 200-kV X-rays produce a threshold erythema, on the extensor surface of the forearm, with a dosage of 540 *r*. The output of a 700-kV X-ray generator at a distance of 50 cm. is 8·6 *r* per min., and that of a 4-gm. radium pack at 6 cm. is 2·8 *r* per min., with this mode of measurement. The equivalent output of the radium pack at distances of 10 cm. and 15 cm. are 1·2 and 0·57 *r* per min. respectively. B. J. L.

2643. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Comparison Based on Clinical Observations. R. F. McNattin. *Am. J. of Roentgenology and Radium Therapy*, **29.** *pp.* **346–351**; *Disc.*, **362–367**, *March*, **1933.**—Deals with the comparative effects of 200 kV and 700 kV X-rays and radium γ-rays in actual clinical treatment of human patients suffering from tumours, etc. The author accentuates that the paper deals with only the more immediate effects, as a sufficient time has not yet passed to allow conclusions to be drawn as to the eventual results. The tumours selected for review relate to the upper respiratory tract. The doses administered were approximately equivalent from each of the three sources of radiation and specific details are given. In the case of 200-kV X-rays the skin reaction is very marked and is least marked in the case of the 700-kV X-rays. On the other hand, after the skin has healed, the mildest effects are in those cases treated with γ-rays, but, in this respect, it is remarked that treatment by 700-kV X-rays is yet too recent to allow of definite comparison. The general constitutional effects of treatment have been mildest in the case of 700-kV X-rays and equally severe with 200 kV X-rays and the radium pack. B. J. L.

2644. Relative Effects Produced by 200-kV and 700-kV X-Rays and γ-Rays. Correlation of Experimental Results. G. Failla. *Am. J. of Roentgenology and Radium Therapy*, **29.** *pp.* **352–362**; *Disc.*, 362–367, *March*, **1933.**—A general review of the results [see six preceding Abstracts], discussed chiefly in respect to the applications of results in practical therapy. The *Drosophila* egg experiments do not allow the existence of differential action, with respect to wave-lengths, to be established, but such a possibility cannot be excluded on the basis of these indefinite experiments. A fairly direct relationship exists between the ionisation chamber experiments and the biological results obtained in the other investigations. The experiments on skin erythema show there is a definite variation with respect to actual wave-length. This result, which cannot be attributed merely to experimental errors, may be explained on the basis of a true differential action of radiation in respect to skin, as opposed to other tissues, or alternatively, to scattering of radiation by the body tissues. If the first conclusion is correct, then a true differential action of the body tissues may reasonably be expected to exist, whereas, if the second conclusion is correct, an apparent differential action must practically occur. Clinical results render a differential action as very likely and almost certain. The results show that the behaviour of radiation emitted at 700 kV is intermediate to that of 200 kV X-rays and γ-rays. Hence better clinical results may be expected with X-rays than hitherto, because of the greater depth dosage which may be obtained and the probability of a differential action. In the *Discussion* the results are reviewed by **C. C. Little** from the biological aspects, by **O. Glasser** from the physical aspects and by **H. Schmitz** and **D. Quick** from the clinical aspect. B. J. L.

2645. Valve-Operated Time-Switch. W. R. Gray. *Brit. J. of Radiology*, **6.** *pp.* **162–165**, *March*, **1933.**—Mechanical time-switches for the interruption of X-ray apparatus circuits are limited in application by their mechanical inertia. A time-switch employing a thyratron valve in conjunction with suitable values of resistance and capacity is described. Without a grid bias, or with too low a bias value, current flows every half cycle. Once the anode voltage is sufficient to cause discharge *via* the tube the grid action is completely ineffective. The grid cannot become negative whilst the discharge lasts, but will react immediately the anode voltage falls to zero. Use is made of this fact to control the rate at which the valve is negatively charged and, thereby, to control an external circuit. The apparatus is described and its action discussed. Dual control for alternative screening and radiographic exposures is possible, by means of a simple switch. The time of exposure is controlled by suitable values of resistance

and capacity between 0·10 and 8·0 seconds. The instrument is precise, simple and not affected by normal fluctuations of the primary mains.
B. J. L.

2646. 500-kV X-Ray Therapy Unit. W. E. Schall. *Brit. J. of Radiology*, 6. *pp.* 175–178 ; *Disc.*, 178, *March*, 1933.—A brief description of a valve X-ray unit, utilising the Villard connections, and employing a primary transformer voltage of 300 kV. B. J. L.

2647. New Radiographic Technique Employing the " Rotalix " Tube. H. Franke. *Brit. J. of Radiology*, 6. *pp.* 179–187 ; *Disc.*, 187, *March*, 1933.—The requirements of X-ray tubes as regards the permissible loading of the anode focal spot are discussed with respect to sharpness of the radiographic image, irrespective of possible loss of definition by movement of the patient, etc. The well-known line-focus tube permits a larger area of load of the anode focus, without loss of definition. Two years after Röntgen's original discovery, the English physicist Wood described the use of a rotating anti-kathode, but, at this time, full use of such rotating electrodes, could not be utilised. The Philips Company has brought to technical success a " Rotalix " tube, in which the anode forms part of the stator of a 3-phase induction motor and, without internal connections, the anode can so be rotated, allowing a larger effective anode surface, with a load capacity 15–20 times that of a simple round-focus, or nine times that of a line-focus. The tube can also be employed on 4-valve apparatus, without any considerable loss of power. Use of this tube allows shorter times of exposure, but the author states that its use does not appear to be economical, unless the tube current amounts to 100 mA or over, at a r.m.s. voltage of 60 kV, the limit of a stationary focus tube being placed at a load of 6 kW. The " Rotalix " tube, an illustration of which is given, is self-protected and built upon shock-proof principles. B. J L.

2648. International Comparison of the Röntgen—The Unit of Quantity of X-Rays. G. W. C. Kaye and W. Binks. *Brit. J. of Radiology*, 6. *pp.* 195–205 ; *Disc.*, 205–206, *April*, 1933.—The 1928 International Congress of Radiology defined and adopted a unit relating to quantity of radiation termed the " Röntgen." Glasser and Meyer, in 1927, had stated that the German R unit, as previously used, differed by about 50 % in respect to the R unit used in the U.S.A. The present paper details the comparison of standards of measurement, as used at the National Physical Laboratory in England, the Physikalisch-Technische Reichsanstalt in Germany and the Bureau of Standards in the U.S.A. The apparatus and methods used for comparison are described and illustrated. The diaphragm, through which the radiation enters the ionisation chamber for measurement, has a different form in the British and U.S.A. Standards. Whilst this difference of form affects the accuracy of the measurements, the difference is practically unimportant. The results obtained with the standard instruments of the three laboratories do not vary beyond 0·5 %. B. J. L.

2649. Value of a Multi-Perforated Screen in Deep X-Ray Therapy : Preliminary Report on a New Method of Delivering Multiple Erythema Doses without Permanent Injury to the Skin. F. Liberson. *Radiology*, 20. *pp.* 186–195, *March*, 1933.—In the treatment of deep seated tumours of the body by X-rays, the dose which can be delivered to the tumour is controlled by the permissible dose delivered to the skin tissues. To overcome this restriction the well-known method of delivering radiation *via* different "ports of entry" is adopted. When using small multiple ports of entry, it is generally agreed that the presence of normal adjoining tissue protects the radiated tissue from the effects of over-dosage. Taking advantage of this fact the author has developed a perforated lead screen, which is interposed between the X-ray tube and the patient, and he claims radiation *via* the perforations of the screen affects the underlying unprotected small areas of tissue, and as these are surrounded by protected areas of tissue, a considerably greater dose may be applied *via* any particular port of entry. Various types of screens have been utilised of lead strips, squares, lattice work, or round or oval perforations. Full details of experimental data are given. From experiments upon rabbits and the human subject, the author states that one and a half to twice the amount of radiation may be delivered to any particular port of entry with the screen as without its use, and the method should have application in radiative treatment. B. J. L.

2650. Simple Integrating Dosage Measuring Instrument. A. Mutscheller. *Radiology*, 20. *pp.* 207–209, *March*, 1933.—In legal controversies, in relation to over-dosage of patients by X-ray treatment, it is of advantage to have some reliable instrument which regulates and records the amount of radiation administered. Such an instrument must not be unduly complicated, or liable to get out of order. The author describes a new type of measuring instrument, utilising a "glow relay tube," having three thorium-coated electrodes, which obviates the use of many amplifying thermionic valves. The instrument is described and is illustrated schematically, and it is claimed that it has simplicity, compactness and ruggedness to a greater extent than other similar existing instruments. B. J. L.

2651. Light and Life. N. Bohr. *Naturwiss.* 21. *pp.* 245–250, *March* 31, 1933. *Nature*, 131. *pp.* 421–423, *March* 25, *and pp.* 457–459, *April* 1, 1933. *Paper read before the Internat. Congress on Light Therapy, Copenhagen, Aug.*, 1932.—The extent of the applicability of the physical and mechanical concepts of atomic theory to the description and study of living organisms is discussed. From the physical point of view the quantum of action together with the existence of elementary particles form the foundation of atomic structure. In the case of biological investigation the necessity of keeping the object of investigation alive makes the elementary fact of the existence of life the starting point. The logical implications of this distinction are considered. J. E. R.

See also Abstracts 2315, 2453.

OSCILLATIONS.

2652. Slightly Damped Short Electric Waves. K. Zakrzewski and M. Miesowicz. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9 A. *pp.* 248–256, *Oct.–Nov.*, 1932. *In German.*—An experimental method is described for the production of slightly damped electric waves of wave-lengths below 10 cm. Full details are included. H. H. Ho.

PHOTOELECTRICITY.

2653. Recent Developments in the Study of the External Photoelectric Effect. L. B. Linford. *Rev. Modern Physics*, 5. *pp.* 34–61, *Jan.*, 1933.—The discussion is limited to the external photoelectric effect, in which electrons are ejected from surfaces by the action of visible, ultraviolet or infra-red radiation. The experimental data are considered critically in the light of quantum mechanical theories. An account is given of: the new electron theory of metals, Wentzel's formulation, Fröhlich's theory for thin films, Tamm and Schubin's theory and Penney's theory. Among the special photoelectric phenomenon discussed are: the effect of temperature on photoelectric emission, saturation phenomena, space charge effects, the spectral selective effect of composite surfaces, the vectorial effect. H. L. B.

2654. Conservation of Energy and Momentum in the Photoelectric Effect. J. Kunz. *Phys. Zeits.* 34. *pp.* 218–219, *March* 1, 1933.—Assuming that in photoelectric emission momentum and energy are conserved and hence that the molecule is set in motion the author deduces the velocity of the emitted electron in terms of the energy of the incident photon and discusses the significance of the result. J. E. R. C.

2655. Classical Distribution of Electrons Due to Photoelectric Absorption of X-Rays. J. Kunz. *Phys. Zeits.* 34. *pp.* 219–220, *March* 1, 1933.—The author compares the purely classical treatment of the photoelectron distribution with the semi-classical and wave-mechanical treatments. It appears that some of the results obtained from semi-classical analysis can be obtained by a purely classical treatment. J. E. R. C.

2656. Action of a Periodically Variable Beam of Light on Metallic Films. Q. Majorana. *Comptes Rendus*, 196. *p.* 396, *Feb.* 6, 1933.—Draws attention to a source of error in a recent experiment on the action of an intermittent beam on thin metallic films [see Abstracts 798 and 1236 (1933)]. The use of a copper disc with a sinusoidal rim and a mercury jet does not give consistent results. He now compensates the periodicity of the current from the thin film by the periodicity of a current from a photoelectric cell periodically illuminated through the same perforated disc. The phase displacement is so near 45° that the conclusions of previous papers may have to be modified. E. E. F. d'A.

2657. Conditions of the Photoelectric Effectiveness of Hydrogen on Platinum. G. Bethe. *Zeits. f. Physik*, 80. 11–12. *pp.* 701–725, *Feb.* 23, 1933.—Hydrogen which diffuses from inside a tube of platinum or palladium does not enhance its photoelectric effectiveness. Neither does it do so after being conducted through liquid sodium-potassium alloy, which extracts the last traces of oxygen and water vapour. The photoelectric effectiveness of the hydrogen can, however, be restored by a glow discharge, which deposits hydrogen in the atomic state. E. E. F. d'A.

2658. Connection between Characteristic Vibration and Selective External Photoelectric Effect. Parts I and II. F. Hlučka. *Zeits. f. Physik*, 81. 1–2. *pp.* 66–79, *March* 3, 1933.—In the first part of this paper the behaviour of tar-colour substances in the visible part of the spectrum is dealt with. Experimental observations are described which indicate that in the case of some of these dyestuffs selective external photoelectric effect and characteristic vibration of the spectral region in the neighbourhood coincide, so that from the observation of photoelectric selectivity a conclusion can be reached regarding the existence of characteristic vibrations and inversely. In the second part of the paper the behaviour of some metals in the ultraviolet is described and this confirms and gives a new example of the statement in the first part. Ag, Au, Pt, Ni, Zn were tested and the experimental evidence shows that they exhibit a selective external photoelectric effect at the place of the characteristic vibrations indicated by their optical data. [See following Abstract.] J. J. S.

2659. Connection between Characteristic Vibration and Selective External Photoelectric Effect. Part III. Behaviour of Coal Tar Substances in the Ultra-Violet. F. Hlučka. *Zeits. f. Physik,* 81. 7–8. *pp.* 521–527, *March* 30, 1933.—In continuation of researches described in former papers [see preceding Abstract] on coal tar substances in the visible region of the spectrum and on metals in the ultra-violet an investigation was made of coal tar substances in the ultra-violet and their photoelectric behaviour there. In this case, in accordance with the earlier results, a direct connection was observed between the external selective photoelectric effect and the optical characteristic vibration. J. J. S.

2660. Periodic Photoelectric Effect of Thin Layers with Monochromatic Illumination. F. Hlučka. *Zeits. f. Physik,* 81. 7–8. *pp.* 516–520, *March* 30, 1933.—A description is given of experiments made for the first time with monochromatic illumination in which a regular periodic course of the photoelectric curves for very thin layers of non-conductors was obtained. As source of light an H-filled discharge tube with a monochromator was used and observations were made on fuchsin and chinalin blue. A short theoretical discussion follows with the object of explaining the phenomenon. J. J. S.

2661. Emission of Electrons from Metallic Films in X-Rays. J. Klein. *Zeits. f. Physik,* 81. 1–2. *pp.* 101–120, *March* 3, 1933.—Investigation of the electron-emission of metallic films in relation to the thickness of the film and the frequency of the incident monochromatic X-rays. Determination of the relation between the " true absorption-coefficients " of metals and the frequency of the incident X-rays. Special attention is given to the relations at the boundary of an absorption. The electron-emission of thick metallic films is inconstant at the boundary of an absorption on account of there being, in addition to the primary absorption, a secondary absorption of fluorescence-rays. The " true absorption-coefficient " is constant at the absorption-boundary, and the rise in the weakening-coefficients is due only to the " true scattering coefficients." For the wave-length tract $\lambda_K < \lambda < \lambda_L$ the " true absorption-coefficient " is proportional to λ, and the photo-emission coefficient to λ^2. A. D.

2662. Photoelectric Emission in a Magnetic Field. R. Schmid. *Ann. d. Physik,* 16. 6. *pp.* 647–656, *March,* 1933.—By means of a simple arrangement an open photoelectric cell at atmospheric pressure can enhance its output of photoelectric emission by means of a magnetic field. The final value of this activity does not in general correspond with the value of the magnetic field, but it would seem as though the photoelectric current is associated definitely with the switching in or out of the field as regards its influence upon the cell. The previous handling or history of the electrodes determines the size of the effect, which does not depend either on the value of the magnetic field or the photoelectric current. The increased diminution of the output potential of the cell through the influence of the magnetic field can possibly be explained by the present results. S. G. B.

See also Abstracts 2357, 2487, 2601.

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